Interim Remedy for Contaminated Groundwater at the CPS Chemical/Madison Industries Site Old Bridge Township, Middlesex County, New Jersey

Appendices

Submitted to:

U.S. Environmental Protection Agency Region II 26 Federal Plaza New York, New York 10278

June 8, 1990



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APPENDIX A-1 TIMELINE

APPENDIX A-1 TIMELINE

Legal actions are represented by light shading

Pre-1967	No "serious problems" with groundwater contamination collected during routine sampling (Ad-Tek pps. 5-6).
1967	CPS Chemicals and Madison Industries (formerly Food Additives) begin plant operations.
5/1970	NJDEP finds high levels of Zn during routine analysis of groundwater samples taken from Perth Amboy's well field.
12/1970 - 9/1970	NJDEP finds Zn at increasing concentrations in Bennet Suction Line (BSL) wells.
1971	City of Perth Amboy finds Zn in BSL wells during routine sampling.
1-3/1971	NJDEP samples surface water (puddles and riverlets) within Madison facility and detects chlorides, sulfates, and nine heavy metals. Zn, Pb, and Cd are detected at high concentrations.
3/1971	State orders Perth Amboy to stop pumping BSL wells (#1-6) as a result of contamination from "chlorides, Zn, and other heavy metals" (Ad-Tek p. 21).
2-4/1973	NJDEP determines that pollutants, originating from Madison Industries, are contaminating the well field via Pricketts Brook.
3-4/1973	Schoor Engineering, on behalf of Sayreville Water Department, detects Cd, Pb, and Zn in groundwater samples, and Cd and Pb in surface-water sample, in excess of New Jersey drinking water standards. Schoor concludes that Pricketts Brook contamination is from stormwater runoff from Madison Industries.

3/9/1973	State orders shutdown of remaining service wells (BSL wells #7-32) as a result of contamination from "chlorides, Zn, Pb, Mn, and possibly other deleterious substances" (Ad-Tek p. 21).
5/16/1973	NJDEP (Joseph Mikulka) compiles data on surface waters in Tennent Pond and Pricketts Brook, and discovers increased concentrations of Pb, Zn, and Fe compared to previous studies.
1973	TV inspection of the Madison Township Sewer Authority (MTSA) industrial trunk sewer reveals a broken lateral connection in the sewer line. MTSA instructed Madisor Industries to install a pretreatment device to reduce the highly acidic effluent being discharged into the main sewer line. The sewer leak is suspected as a main source of contamination from the Madison Industries site.
5/31/1973	NJDEP orders Madison Industries to cease the discharge of improperly treated industrial wastewaters to Pricketts Brook (by 1975 Madison Industries still had not complied).
1973	Pricketts Pond constructed.
6-9/1973	NJDEP samples surface water from Pricketts Brook and finds high concentrations of Zn and Fe downgradient of the Madison property.
1973	Madison/CPS site is paved, potentially reducing the direct discharge to the soil, but increasing stormwater runoff.
9/1974	Citizens complain of acid fumes.
1974-1975	Ad-Tek samples surface water, groundwater, sediment, and soils for metals and finds high levels of Zn in groundwater samples. Ad-Tek concludes that Madison Industries is the source of metal contamination. Highest levels of Pb and Zn were detected in soil samples collected south and northwest of the Madison Industries site. Ad-Tek also suggests that Pricketts Brook sediments were contaminated by runoff from the broken sewer line.

1/1975	Dr. Faust (on behalf of Madison Industries) samples surface water and soil in the Pricketts Brook watershed and finds a "virtual absence" of Cd, Pb, and Cr in Pricketts Brook. He concludes that there is not a hazard for the Perth Amboy water supply (Ad-Tek p.24).
1976-1978	NJDEP conducts groundwater sampling and analyses, and tests for and detects five constituents (Zn, Pb, Cd, MeCl and 1,1,2,2-tetrachlolroethane) and 32 other organics. This is the first time organics are detected in groundwater samples. SUMMARY REPORT NOT PROVIDED.
4/1976	Citizens complain of bad odor.
11/1977	CPS employees complain of acid odor and particulate furnigation. The source is believed to be Madison Industries, who would not allow a site investigation. A violation is cited to Madison.
7/1979	Madison Industries is ordered to cease the open burning of refuse, including Zn powder, which is a violation of NJ Air Pollution laws.
8/1979	Citizens complain of crop and car paint damage. A follow-up investigation reveals an accidental discharge from CPS of a mixture of methanol and water and smaller amounts of dimethyl adipate. CPS agrees to pay for damages.
1979	NJ Superior Court issues a court order to investigate and determine the feasibility of removing contaminated groundwater and soil.
1980	The court commissions Dames & Moore (D&M) to address the court order. D&M proposes the following: a slurry cutoff wall encompassing the CPS/Madison properties to isolate contaminated groundwater; rerouting of Pricketts Brook; and dredging of Pricketts Pond.
1980	D&M samples for the 5 constituents and finds Pb and Cd in groundwater samples. D&M also finds Pb in soils, the highest occurring downgradient of Madison Industries.

6/1981	NJ Superior Court files an order mandating implementation of remediation plan base on D&M's evaluation
10/1981	NJ Superior Court judgment finds CPS and Madison Industries guilty of polluting the groundwater and awarded the State and the City of Perth Amboy \$5.2 million for a remedial and contamination plan.
~1981	CPS/Madison appeal to the Court.
1982	Converse Consultants, on behalf of Madison Industries, determines that the propose confining soil layer (South Amboy Fire Clay) to be used in conjunction with the slurry wall is discontinuous. Converse consultants suggests that a partial slurry wall would be more cost-effective.
3/1982	Princeton Aqua Science (PAS), on behalf of NJDEP, conducts groundwater samplin and tests for Zn, Pb, Cd, and Cu. SUMMARY REPORT NOT PROVIDED.
5/1982	CPS/Madison site is listed on Superfund National Priorities List (NPL).
8/1982	Site investigation (SI) is conducted under the authority of CERCLA. Activities at the site include midnight dumping and repeated spills. The SI also mentions that site operators are under at least 50 criminal indictments for illegally dumping hazardous wastes into the sanitary sewer. Appellate court affirms the 1981 judgment and remands it to the Trial Court for an amended judgment.
5/1983	Wehran Engineering, on behalf of CPS, indicates that the South Amboy Fire Clay (uppermost clay unit); is discontinuous. However, the deeper Woodbridge Clay is continuous and could be an effective confining layer for the court's original proposed perimeter cutoff wall. Wehran suggests the installation of a crescent-shaped slurry wall downgradient and above the head of Pricketts Pond.

5/23/1983	Converse, on behalf of Madison, concludes that Madison is the source of heavy metals contamination; however, the level of contamination is lower than previously reported. Converse also recommends a cost-effective remedial plan, including the following: installation of an impervious slurry wall and an inceptor well, in accordance with the Wehran plan; installation of a discharge line to the MTSA line and 8 to 10 monitoring wells; backfill of Pricketts Pond upstream of the slurry wall; and diversion of Pricketts Brook.
5/1983-3/1984	Wehran provides amendments to their proposed remedial action plan.
6/1983	Trail Court amends the 1981 order. The proposed remedial action is modified. The Appellate Court upheld the Superior Court decision and modified it by lifting cost cap and making companies jointly and severally liable. The NJDEP begins reviewing the proposed modification to the remedial action.
1983	CPS is indicted on charge of disposing of hazardous wastes by dumping them into the Old Bridge sewer system (Star-Ledger 1984).
9/1983	PAS, on behalf of NJDEP, finds that either the influent (into the Middlesex County Utilities Authority treatment system) should be diluted, or the groundwater should be pretreated to remove primary pollutant metals (Zn, Pb, Cu) and purgeable organics.
1984	CPS is suspected of tampering with monitoring wells (Star-Ledger 1984).
4/1984	Converse & Wehran (on behalf of Madison and CPS) sample for metals and VOCs detected in pond sediments and indicate that the extent of contamination is much less than determined by Ad-Tek and D&M.
4/17/1984	HydroQual suggests that conclusions presented in the 1983 PAS report are in error and do not adequately address the purpose of the investigation.
6/20/1984	NJDEP conducts surface-water sampling in Pricketts Brook and tests for Zn, Pb, Cd, Cu, and halogenated and aromatic volatiles. SUMMARY REPORT NOT PROVIDED.

8/1984	CH2M Hill, on behalf of NJDEP, proposes expansion of the slurry wall to the south a southwest to enclose the entire area of known contamination (which extended to the northern portion of Pricketts Pond), eliminating the need for decontamination wells outside of the wall.
9-11/1984	NJDEP determines that the modified remedial action plan proposed by Wehran & Converse is adequate.
9/1985	NJ Supreme Court approves modified remedial action plan. The proposed modified remedial plan returns to Middlesex County Superior Court due to the City of Perth Amboy's objections.
5/1986	To determine the feasibility of implementing the court order, Wehran submits a repo evaluating the extent of the South Amboy Fire Clay at the CPS/Madison site.
4/9/1987	Additional analytical results for VOCs and metals in groundwater are presented by Wehran.
6/24/1987	As requested by the NJ Superior Court, Richard Olsson investigates the occurrence of the South Amboy Fire Clay and finds that it is too thin and discontinuous to serve as a confining unit for the containment wall.
4/1988	Final court order requires implementing a remedial plan that includes the following: a slurry wall in conjunction with a groundwater recovery system, as proposed by Wehran (3/28/84); relocation of the Pricketts Brook, as proposed by Converse (5/27 83); and discharge of the recovered groundwater to the sewage treatment plant.
11/1988	Wehran installs 13 "DW" wells and conducts groundwater sampling for Zn, Cu, Pb, Cd, and VOCs. Wehran finds that metals (especially Zn) are present with the higher concentrations contained on the Madison property and volatiles are still present in the groundwater.

11/1/1988	CDM prepares a draft completeness review of documents containing information and data on the CPS/Madison site.
4/1989	Wehran prepares a report analyzing sampling results from 1988. Wehran recommends that further groundwater sampling be conducted to confirm results of existing data. The additional groundwater sampling data can be used to predict an effective location of the recovery wells through computer models. Wehran also recommends that additional data concerning the Evor Phillips Site and other potential sources of contamination be evaluated to determine the impact on the CPS/Madison remediation program. The Wehran (1989) report showed that the full extent of the contamination has not been determined. All of the contaminated groundwater is not discharging in the Pricketts Pond. Thus, additional plume delineation is necessary and the remediation system will have to be redesigned.

APPENDIX A-2 GROUNDWATER ANALYSES FOR FIVE SELECTED CONSTITUENTS

GROUNDWATER CONTAMINATION OF FIVE CONSTITUENTS

1					Zinc																						
SOURCE:	WEH,89	WEH,87	NIDEP,85	CON,83	PAS,82	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	AT,75	DM,80	DM,80	DM,80	DM,80
SAMPLE	₹:								NJDEP											NIDEP	NIDEP	NIDEP		NJDEP	NJDEP	NJDEP	
DATE:	11/88	3/87	5/85	5/83	3/82	10/79	10/77	9/12/	9/6/	8/77	<i>5/11</i>	8/76	6/76	5/76	4/76	11/75	10/75		9/13/	8/75	6/75	5/75	12/74	2/74	5/73	4/73	3/73
WELLS:		10.32						(24			400	74						75									
M-1	260	18.27		42 36	25 779	470	1660	625 1125			500 525	75 1150				6.34		108 3560									
M-2 M-3	209	[4.3]		0.22		2.3	1.7		2.475		0.725	1130				5.8										 	
M-4		0.244		0.08			0.202	0.275	4.415		0.45	0.35				3.73	0.55	1.6									
M-5		0.796		1.2			0.115	0.15			0.1					0.85	0.45	1.11	0.8						1		
M-6	3.41	5.225		17				,								•											
S-1						0.36	1.3	0.45	0.5	97.7												•					
S-2							0.798	0.8		0.328																	
S-3							2.305	3.1		1.55																	
<u>^</u>		18.21	10.85	22	4.83	64	179	218	155							2 07	0.44	0.46			515		7.8				
B C		0.32	9.09	45	0.216	27	0.232	0.275	0.199							2.07		0.46			3.25	0.66	< 0.02				
D					0.210	6.3	12.2	12.5								6.17		19.75				20.05	8.2				
E						0.22	0.274	0.2				0.425			0.4						0.65		< 0.02				
F							0.943	0.275				0.65			0.85			2.6			1.4		< 0.02				
G							0.485	0.6			0.375	1.05			0.8			2.1			0.35		< 0.02	•		-	
Н											0.7	0.5			0.55	0.43	0.51	0.49			0.75	1.12	< 0.02				
No.1													ND								1.6	2.4	1.7				
No.2							0.465						ND														
No.3		•	6.625						,				ND					·				4.96		78.75			
No.4									:				2.7 ND	0.36	5.3 0.01						··· ·		1.4		<u>-</u>		
No.5 No.6		 											עא		0.01											•	
No.7																						٠		•			
No.8																											-
No.9																											-
No.10			8.125	13	0.962	·																					
No.11					1.25																		< 0.02				
No.12				97	156																		< 0.02				
No.13								-:															0.02				
No.14 No.15																											
No.16					0.404										1.2										•••		
No.17												-															
No.18				·.																							
No.19					0.562																						
No.20																											
No.21 No.22		,																									
WCC-IM	0.428				0.586																	· 					
WCC-IM	0.428				0.388				<u> </u>																		
WCC-2	1.31								-																		
WCC-2M					0.428																						
WCC-3S																											
WCC-3M	0.424				0.447																						
WCC-3D	0.403				0.351																						
WCC-4S					0.950																						
WCC-4M WCC-4D					3.82																						
WCC-3S					0.288										•												
WCC-6S	0.82				0.486																						
WCC-6M	0.259				1.18		• • • • • • • • • • • • • • • • • • • •																				
WCC-6D			- **· **		1.04																						
WCC-7M					1.61																						
WCC-9S		5.415		1.8	3.44								-														
WCC-9M		1.988		3.9											_												

ı						Zinc																						
SOURCE:	WEH,	89 W	VEH,87	NIDEP,05	CON,83	PAS,82	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	AT,75		DM,80		
SAMPLE	R:					•								NIDEP												NJDEP		
DATE:	11/88	3	/87	5/85	5/83	3/82	10/79	10/77	9/12/	9/6/	8/77	5/77	8/76	6/76	5/76	4/76	11/75	10/75	9/24/ 75		8/75	6/75	5/75	12/74	2/74	5/73	4/73	3/73
WELLS: WCC-11S	6	97	0 33		110	20.9				, —																		
WCC-11		.4 0			0.39	15.6																						
WCC-IID	·		.998			5.5																						
WCC-12	M 0.0	21			0.13	0.892																						
WCC-13	M 0.1	74		•	0.18																							
WCC-14S					0.8	0.161													-							+		
WCC-15\$.—			0.03	0.216																						
WCC-ISD	WI/ W		•		0.75	0.149																						
WCC-16S	7	1.1			0.17	0.51					•	• • •																
SCHOOR:																												
SE-1																												
SE-2																												
SE-3 SE-4						· · · · · · · · · · · · · · · · · · ·																		-				
LAYNE:																												
L-1				·																								
L-1A										Ċ														 				
L-2													·													ND	ND	0.025
L-3																									1.175	15	0.25	0.3
L-4 L-5																									0.22		0.15	
WEHRAN			~													****												
WE-I																												
₩E-2																												
WE-3																												
WE-4 T-I			0 64	289.6	210											-												
T-2			8.54	289.0	210					·																		
DEP-1	0.3	78																										
DEP-2	0.3	54													-													
DEP-3																												
DEP-4	7.																											
DW-1S	0.9																											
DW-25	0.6									-																		
DW-3S	0.5																											
DW-3D	0.0	88																										
DW-4S	1.																											
DW-4D DW-5S	0.2																											
DW-35	0.0																											
DW-6S	0.9																											
DW-6D	0.1	51																										
DW-7S	0.1																											
DW-7D	0.0	65														· · · · · · · · · · · · · · · · · · ·												
Say-Pro A FB-1	0.0	47 0	141	0.101																								
FB-2	< 0.0		.131			· · · · · · · · · · · · · · · · · · ·																						
FB-3	< 0.0																											
FB-4																												
TB-1		0	.051																									
TB-2				·																								
TB-3 TB-4																												
MB					·																·							
	Ь																										_	

1	l					Load																						
SOURCE:	WEH,89	WEH,87	NJDEP,85	α	ON,83	PAS,82	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM.80	DM.80	DM.80	DM,80	AT.75	DM,80	DM.80	DM,80	DM.80
SAMPLE								NIDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NIDEP	NJDEP	NJDEP	NJDEP	NJDEP	NIDEP	NJDEP	NIDER	NIDEP	,			NJDEP	
DATE:	11/88	3/87	5/85	5/	83	3/82			9/12/				8/76	6/76	5/76		11/75	10/75		9/13/		6/75	5/75	12/74				3/73
WELLS:																			75	75								
M-1		0.322			0.2	0.316	0.16		0.8			0.555				0.003	0.017	0.002	0.042	0.005	0.043							
M-2	0.376	0.948		<		0.442	0.27	0.014	0.001			0.019				0.024	0.088	0.041	0.015	0.034	0.062							
M-3				<			0.2		0.001	0.051		0.007	0.013			0.003	0.003	0.004										
M-4		0.005		<u><</u>				ND	0.003		· · · · ·	0.007	0.016			0.015			0.001	0.005								
M-5 M-6	0.014	0.474		{- -				ND	0.003			0.009	0.024			0.017	0.003	0.004	0.002	0.004	0.008							
S-1	0.014	0.003			0.1	· · · ·	0.36	0.008	0.004	ND	0.062				,												· · ·	
S-2							0.30	0.026	0.009		0.328															+		
S-3				-				0.11	0.016	0.088	0.092												-					
Λ		0.005	0.025	<	0.1	0.027	< 0.03	0.052	0.037	0.034												0.023		< 0.005	***			
В		0.018	0.005	<	0.1		< 0.03		ND	ND							0.005	0.004	0.003					< 0.005				
С						0.02				0.117							0.003					0.000		< 0.005				
D							< 0.03	0.008	0.013	0.017							0.023		0.015			0.008	0.082	< 0.005	•		~	
E							0.05	0.008	0.009	0.018			0.09			18.4	ND	0.004	0.003			0.000	0.023	< 0.005				
F								0.008	ND	0.009			0.019			0.016	0.069		0.035			0.00	0.016	< 0.005				
G								0.008	0.001	0.015		0.013				0.004	0.006						5 0.006					
Н												0.01	0.047			0.027	0.101	0.011	0.008					< 0.005				
No.1 No.2														ND								0.006	0.014	< 0.005				
No.3			0.041					0.008				-		ND ND									0.002	1.0.00€	0.004			
No.4		<u>·</u>	0.041					0.006						ND	0.002	0.003							0.003	< 0.005	0.004			
No.5							·							0.002	0.002	0.003								< 0.003				
No.6							-							0.002		0.003												
No.7																												
No.8											-						~		-									
No.9																		•										
No.10			0.063		0.2	0.342			·	·																		
No.11						0.034																		< 0.005				
No.12 No.13					0.2	6.92										0.002												
No.14																								< 0.005		· · · · · ·		
No.15																												
No.16			* ,,,,,,			0.017										0.003				-								
No.17																0.003												
No.18		****												-					-									
No.19						0.024							-	-														
No.20												•																
No.21						_																						
No.22	^ ***																											
WCC-IM	0.013 • 0.0014					0.03																						
WCC-1D	< 0.0014					0.074		•																				
WCC-2M	- 5.071					0.051																						
WCC-3S					<u> </u>	3.031		,																				
WCC-3M	< 0.091					0.04																						
WCC-3D	• 0.003					0.071																						
WCC-4S						0.03																						
WCC-4M						0.203																						
WCC-4D																												
WCC-5S					<	0.017																						
WCC-6S WCC-6M	0.0014					0.022																						
WCC-6D	0.0078					0.074																						
WCC-7M						0.03					-													-				
WCC-9S		0.005		- (0.1	0.071																						
WCC-9M		0.005			0.1																							
WCC-9D				_		0.04																						
											•																	

	1				Load																						
SOURCE:	WEH,89	WEH,87	NJDEP,85	CON,83	PAS,82	DM,	80 DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	AT,75	DM,80	DM,80	DM,80	DM,80
SAMPLE	1									NIDEP															NJDEP		
DATE:	11/88	3/87	5/85	5/83	3/82	10/7	9 10/77	9/12/	9/6/	8/77	5/77	8/76	6/76	5/76	4/76	11/75	10/75		9/13/	8/75	6/75	5/75	12/74	2/74	5/73	4/73	3/73
WELLS:	* 0.0025	0.028		< 0.1	0.061													75	75								
WCC-11	• 0.0038			< 0.1	0.105																						
WCC-IID		0.005			0.098																	·					
WCC-12	• 0.0039			< 0.1	0.054				_																		
WCC-13	• 0.0032			< 0.1	0.071																						
WCC-14S				< 0.1	0.071										**										•		<u></u>
WCC-158	 			< 0.1 < 0.1	0.078																				·		
WCC-15D	ļ			<u> </u>	0.071											-											
WCC-16S				< 0.1	0.084	-																					
SCHOOR:																											
SE-I																											
SE-2																											
SE-3																											
SE-4 LAYNE:	 										-																
L-1	 		 										<u> </u>	·· ···													
L-IA	 										•					·····											
L-2																	····								ND	0.001	0.01
L-3																										·	
L-4																								0.006		0.005	
L-5 WEHRAN	 																							0.004	0.005	0.004	0.011
≫ WE-I	 																										
WE-2												-		·			····										
₩E-3	 											-															
WE-4																	••								·		
T-1		0.005	0.375	0.2												-											
T-2																											
DEP-1 DEP-2	• 0.002 • 0.0011																										
DEP-3	0.0011	-																									
DEP-4	0.007																										
DW-1S	< 0.00091													-													
DW-ID	< 0.00091																										
DW-2S	< 0.00091																										
DW-3\$	< 0.00091																										
DW-3D DW-4S	< 0.00091																										
DW-4D	< 0.00091													-		-											
DW-5S	< 0.00091																										
DW-5D	< 0.00091																										
DW-6S	• 0.00098																										
DW-6D	0.0055																										
DW-78	< 0.00091												· ·														
DW-7D	< 0.00091		0.006																								
Sey-Pro A	• 0.0012	0.025	0.000																								
	< 0.00091	0.025						,																			
FB-3	• 0.0032																										
FB-4													:														
TB-1		0.043																									
TB-2																											
TB-3 TB-4	 																										
15-4																											
МВ																											

	C	dmium																									
SOURCE:				NJDEP,85	CON,83	PAS,82	D	4,80 DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	AT,75	DM,80	DM,80	DM,80								
SAMPLE	1							NJDEF	NIDEP	NJDEP	NIDEP	NIDEP	NIDEP	NJDEP							NIDEP	NIDEP	NIDEP		NIDEP	NIDEP	
DATE:	111/	/88	3/87	5/85	5/83	3/82	10	/79 10/77		9/6/	8/77	5/77	8/76	6/76	5/76	4/76	11/75	10/75	9/24/	9/13/	8/75	6/75	5/75	12/74	5/73	4/73	3/73
WELLS:	ļ								75	75									75								
M-1	 		0.078		0.54	0.051).17	1.7			0.4				0.011	0.031	0.024		0.024							
M-2 M-3	ļ	1.48	0.06		< 0.02	2.01		0.07 0.3		0.007		0.028	0.058			0.031	0.039	0.08	0.061	0.09	0.09						
M-4	├		0.005		< 0.04		< (ND	ND	0.007		ND	ND			0.005	0.001	0.003	0.002	0.007	0.016						
M-5	t -		0.005		< 0.02			ND	ND			ND	ND			0.005	0.002	0.004	0.003	0.003							
M-6	1	0.023	0.015		0.13																	· · ·					
S-1	<u> </u>						< (.01 ND	0.003	0.001	0.01																
S-2	1							0.004	0.006	0.003	0.002														1		
S-3								0.007	0.007	0.005	0.009																
٨	<u> </u>		0.005		< 0.02 <	0.003	< (•											0.006		0.001			
B	<u> </u>		. 0.005	0.001	< 0.02			.01 ND	0.003								0.001	0.002	0.004			ND	0.011				
. <u>c</u>	ļ				<	0.003				ND							0.002					0.006		0.001			
D E	ļ						< (0.001			0.002	0.013	0.004	0.015			ND	0.025				
F		_						0.002					ND			0.002	0.002	0.004	0.02	····		ND 0.007	0.026 <				
G								0.003			-	0.002				0.002	0.001	0.003	0.04				0.017 <				
H	ł			-				0.003	0.005	0.002		0.002				0.002	0.001	0.003	0.005				0.002 <				
No.1	 					· · · · · · · · · · · · · · · · · · ·		·						ND									0.017 <			* **	
No.2														ND			•		,								
No.3	1		+	0.017				0.002						ND				,					0.031 <	0.001			
No.4						-								ND	0.001	0.003							. <	0.001			
No.5	<u> </u>													0.003		0.07											
No.6	L																										
No.7	ļ																										
No.8																											
No.9				0.001	1 000	0.001			····				·														
No.10 No.11	 			0.001	< 0.02 <																			0.001			
No.12	 				< 0.02	0.126		·								0.003	·							0.001	-		
No.13	 																•							0.001			
No.14																											
No.15									*				-					*-									
No.16					<	0.003										0.021	,,,										
No.17																	•										
No.18																											
No.19					<	0.003																	-				
No.20	ļ																										
No.21													-								-						
WCC-IM	< 0.	0043	·····		<	0.003																					
WCC-1D		0043			 	0.006																					
WCC-2		0043						,								-											
WCC-2M						0.021																					
WCC-3S																											
WCC-3M		.0043				0.009																					
WCC-3D	< 0.	.0043			<																						
WCC-4S						0.008																		——			
WCC-4M	ļ					0.007																				——	
WCC-4D WCC-5S																											
WCC-6S	< 0.	.0043			<																						
WCC-6M		.0043			·	0.006																					
WCC-6D	1	<u></u> _				0.012																					
WCC-7M						0.012																					
WCC-9S			0.005		< 0.02	0.006																					
WCC-9M			0.005		< 0.02																						
WCC-9D	L					0.022																					

		Cadmiur		•																								
SOURCE		WEH,89	WEH,8	NJDEP,85	C	ON,83	PAS,82	DM,8	0 DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM.80	DM.80	DM,80	AT 75	DM 80	DM 80	DM,80
SAMPLE	ĺ								NJDEP	NIDEP	NJDEP	NIDEP	NIDEP	NJDEP	NJDEP	NJDEP	NJDEP	NIDEP	NJDEP	NIDEP	NJDEP	NIDEP	NIDEP	NIDEP	,,,,		NIDEP	
DATE:	ĺ	11/88	3/87	5/85	5/1	83	3/82	10/79	10/77	9/12/	9/6/	8/77	5/77	8/76	6/76	5/76	4/76	11/75				8/75	6/75	5/75	12/74			3/73
WELLS:	↓									75	75									75						• • • •		
WCC-115		0.0043			< 0		0.004																					
WCC-11		0.0043			< 0	.02 <	0.003																					
WCC-11E		0.0043	0.005				0.011																					
WCC-13		0.0043			< 0		0.004																					
WCC-14S		0.0043			< 0		0.011																					
WCC-158					~ 0		0.004																			4		
WCC-15					\ \ 0																							
WCC-15D	1						0.009																					
WCC-168	<	0.0043			< 0	.02	0.003																					
SCHOOR:																												
SE-I																												
SE-2																										_		
SE-3														-														
SE-4																												
LAYNE:																												
L-I																												
L-1A L-2											_																	
L-2 L-3																										ND	ND	ND
L-4																												
L-5																										0.002	ND	0.001
WEHRAN																										ND	ND	0.002
WE-1																					-							
WE-2			·				-																					
₩F-3																												
WE-4																												
T-1			1.694	0.012	0.	97							***	-														
T-2											***		****							·								
		0.0043																										
DEP-2	< (0.0043																										
DEP-3 DEP-4		<u> </u>																										
		0.017																										·
DW-1D		0.0043																										
		0.0043																										
DW-3S		0.0043																										
DW-3D		0.0043																<u> </u>										
DW-4S		0.0043																										
DW-4D	< 0	0.0043																										
DW-5S	< (0.0043				-																						
DW-5D		0.0043																										
DW-6S		0.0043																										
DW-6D		0.0043									•			······································					·									
DW-7\$		0.0043																										·
DW-7D Say-Pro A	< (0.0043		0.001																-								
FB-1	- (0.0043	0.005	0.001																								
		0.0043	0.005																									
FB-3		0.0043																										
FB-4																												
TB-I			0.005																									
TB-2																									-			
TB-3																												
TB-4																												
МВ																								· · · · · · · · · · · · · · · · · · ·				
																					:							

SOURCE	1 11/1	TH 80	Methylen			12 BAE 62	D14 90	D14 80 D14 80	D) 4 00	D14 00								etrachloroeth							
SAMPLE		:H,89	WEH,87	NJUEP,	,85 CON,1	13 PAS,82	DM,80	DM,80 DM,80 NJDEP FAUST					DM,80		AT,75	WEH,89	WEH,87	NJDEP,85	CON,8	3 PAS,82	DM,80		DM,80		AT,75
DATE:	1	88	3/87	5/8	5 5/83	3/82	10/79	12/78 10/78	7/78	10/77		9/6/	8/77	4/76	12/74	11/88	3/87	5/85	4/92	3/82	10/79	NJDEP 12/78	FAUST 10/78	NIDEP	
WELLS:	1										75			47.0	12//4	1	3/07	3/63	3/63	3/62	10/79	12/18	10/78	7/78	12/74
M-1	I					ND	< 0.01	0.073		ND	ND			< 0.0001		<u> </u>				ND	0.01	0.0011			
M-2	ļ <u> </u>	0.016				ND	0.16	0.053			ND			< 0.0001		< 0.01				ND	0.054	< 0.0005			
M-3 M-4	-		ND	-			83	2.6		4.3				0.12			ND				4.51	0.24			
M-5	├ ─							< 0.0008 0.0012		ND ND	ND			< 0.0001								0.0013			
M-6	\vdash	0.43					•	0.0012		עא	ND			< 0.0001		< 0.01						< 0.0007			
S-1	t						67	10.3		1.9	0.85	ND	8.5			0.01					8.43	8			
S-2							-	< 0.0008		ND	ND	ND	ND									< 0.0007	•		
S-3	<u> </u>							0.0024		ND	ND	ND	ND		•					*		< 0.0007			
<u> </u>	ļ						0.01	0.0482									ND			ND	< 0.01	0.0007	0.0137		
В	 			1.	4		18.7	103 391	102	1.7	5.2		2				ND	0.049			3.3	8.4	3.853	1.43	
C D							- 001	4.0.0004	0.0048			ND				ļ	ND			ND				< 0.0004	
E								< 0.0005 < 0.0005	0.0004 < 0.0004		ND ND	ND		- 0.0001		<u> </u>					< 0.01	0.0004		< 0.0004	
F	 						0.017	~ 0.0003	< 0.0004	ND	ND	ND ND		< 0.0001							< 0.01	0.0016		< 0.0004	
G	 							< 0.0005	< 0.0004		ND	ND		< 0.0001								< 0.0004	·	< 0.0004	
Н							*******							< 0.0001								0.0003	-	₹ 0.0004	
No.1								0.257														0.0033			
No.2																									
No.3	ļ							< 0.0005 0.0046	0.042													< 0.0005		< 0.0004	
No.4 No.5	 							0.0017		A155															
No.6								< 0.0008 0.0072		ND								 				< 0.0007		-	
No.7	 																								
No.8																									
No.9								· · · · · · · · · · · · · · · · · · ·														•			
No.10	· .					ND		1.23												ND					
No.11	ļ					0.0024		21.33												ND			1.677		
No.12 No.13	 			1.	2	17	*-											0.094		ND					
No.14																									
No.15																									
No.16	†					ND		0.014	0.013			<u> </u>								ND		0.0004			
No.17											~														
No.18								0.0027																	
No.19	ļ					ND														ND					
No.20 No.21											 														
No.22																									
WCC-IM	< 1	0.01	ND			ND										< 0.01	0.011			ND					
WCC-ID		0.01				ND										< 0.01	ND			ND					
WCC-2		0.01														< 0.01				•					
WCC-2M						ND	,													ND				·	
WCC-3S																									
WCC-3M		0.01				ND										< 0.01	_			ND					
WCC-4S	< (0.01				ND										< 0.01				ND					
WCC-4M						ND ND														ND ND					·
WCC-4D						ND														NU					
WCC-5S						ND														ND					
WCC-6S		10.0				3.845											ND			ND					
WCC-6M	٧ (0.01				ND										< 0.01	ND			ND					
WCC-6D		1	ND			ND							· ·				ND			ND					
WCC-9S			MD			0.0098									 -∤		ND			ND					
WCC-9S			ND 0.68			ND						4.3					S0			NI)					
WCC-9D						0.218	 .								•				-	NO	· — — — — —				

1	ı		Methylene e	thlorida												,	l.	1.122	-tetrachloroethane						
SOURCE:	w	EH.89	WEH,87 N		CON.83	PAS.82	DM,80	DM,80	DM,80	DM.80	DM.80	DM.80	DM.80	DM,80	DM,80	AT,75	WEH,	9 WEH.	7 NJDEP,85 CON,	83 PAS.82	DM,80	DM.80	DM,80	DM.80	AT,75
SAMPLE		,			,		,	NJDEP						NIDEP	NJDEP	•				,	2,	-	FAUST	NJDEP	
DATE:	11	/88	3/87	5/85	5/83	3/82	10/79	12/78	10/78	7/78	10/77			8/77		12/74	11/88	3/87	5/85 5/83	. 3/82	10/79	12/78		7/78	12/74
WELLS:												75													
WCC-11S	<	0.01	ND			ND											< 0.01	ND		ND					
WCC-11	<	0.01				ND											< 0.01			ND					
WCC-11D						ND														ND					
WCC-12	<	0.01	0.96			ND											< 0.01			ND					
WCC-13	<	0.01	ND														< 0.01	ND							
WCC-14S					_	ND											<u> </u>		· · · · · · · · · · · · · · · · · · ·	ND					
WCC-15S			ND	18		0.034												ND	0.063	ND					
WCC-15			ND			0.00/0												ND			·				
WCC-15D		0.01	NE			0.0267											ļ			0.0203					
WCC-16S	<u> </u>	0.01	עא			0.0079											< 0.01	0.0	3	ND					
SCHOOR:																	ļ								
SE-1 SE-2																	<u> </u>								
SE-3																									
SE-4																	 		·						
LAYNE:					-																				
L-I																									
L-1A																									
L-2																							-		
L-3																	 	·							
L-4																									
L-5			***************************************																						
WEHRAN										,															
WE-I																									
_ WE-2																									
√ WE-3																									
WE-4																									
T-1			0.14	0.069														ND	0.003						
T-2																									
DEP-1 DEP-2	<	0.01	0.002									•			٠		< 0.01	0.00	!						
DEP-2 DEP-3	<	0.01	0.059 ND													-	< 0.01	ND ND							
DEP-4	<	0.01	עא														< 0.01	עא							
DW-IS	`	0.01									-						< 0.01								
DW-ID	~	0.01			•••												0.012								
DW-2S	~	0.01															< 0.012								
DW-3S	<	0.01															< 0.01								
DW-3D	~	0.01															< 0.01								
DW-4S	~	0.01															< 0.01								
DW-4D	<	0.01							-								< 0.01								
DW-5S	<	0.01															< 0.01								
DW-5D	<	0.01															0.039								
DW-6S	<	0.01															< 0.01								
DW-6D	<	0.01															< 0.01								
DW-7\$	<	0.01															< 0.01								
DW-7D	<	0.01															0.059								
Say-Pro A																									
	<u> </u>	0.01																ND							
FB-2	<	0.01															< 0.01	ND							
FB-3	<u> </u>	0.01															< 0.01								
FB-4		0.01	ND															ND							
TB-I	<u> </u>	0.01															< 0.01								
TB-2 TB-3		0.026															< 0.01								
TB-4	<	0.01											<u>-</u>			, !	€ 0.01								
MB			0.002			3.1										•				ND					
.4112																•								 -	

GROUNDWATER CONTAMINATION OF FIVE CONSTITUENTS (Continued)

NOTES:

- o Ad-Tek lists well numbers which are assumed to be BSL wells (p.49)
- o Duplicate samples were averaged
- o Values are in milligrams per liter (mg/l)
- o In Wehran, 1989, wells WCC-11VS and WCC-16VS are assumed to be the same as WCC-11S and WCC-16S, respectively
- o Less than values from Wehran, 1989 were analyzed but not detected; the value reported is the instrument detection limit
- = valued that is less than the detection limit required in Wehran's contract (Wehran, 1989)
- o + = Avg. of Wells NO.3 and NO.3A. (The sampling of well NO.3A is treated
 - as a replicate of well NO.3 although it was sampled the following day NJDEP, 1985)
- o Say-Pro A = Sayreville Production well A

APPENDIX A-3 GROUNDWATER ORGANIC ANALYSES

ORGANICS DETECTED IN ALL WELLS (ppb)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
1,2-Dichloroethane					
Α		6.8			
В			210	16	
DEP-1	10			22	
DW-1D					24
DW-2S					
DW-3D					
DW-3S					
DW-4D	•				
DW-4S					
DW-5D				·	13
DW-5S					
DW-6D					
DW-6S					
DW-7S					
M-1		6.5			
M-2		53			88
M-6					670
No.3		•	15		
No.11		12.3			
No.12		4200	770		
T-1			208		
WCC-1D		16.0			
WCC-1M	01		,	140	68
WCC-3M		5.8			
WCC-6D	17			28	
WCC-6S	(1)	440			
WCC-6S	(2)	54			
WCC-9D		69			
WCC-9M	03			1200	
WCC-9S	04			17	
WCC-11D		8.0			
WCC-11M					28
WCC-11M		22.6			
WCC-11S	07	15.8		12	
WCC-12M	08			1200	80
WCC-15D		24.4			
WCC-15M	13			120	
WCC-15S		106			
WCC-15S			2000		
All Others	·	<1	•	<5	
		<u> </u>			

ORGANICS DETECTED IN ALL WELLS (ppb) (Continued)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
1,1-Dichloroethane					
A	05			640	
В			14		
M-3	20			13	
No.12		117	2		
T-1	19			400	
WCC-6S	(1)	206			
WCC-6S	(2)	10.2			
WCC-7M		16.9			
WCC-15D		4.5			
WCC-15S		1.7	22		
All Others		<1		<5	
·					
1,1-Dichloroethene					
В			3		
No.12			3		
WCC-15S		·	6		
Carbon Tetrachloride					
A		9.2			<u> </u>
В			6.5		
No.11	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	6.0			
No.12		1750			
No.16		15.0			
WCC-1D		15.0			
WCC-6D	(4)	104			
WCC-6S	(1)	4480			
WCC-6S	(2)	69			
WCC-7M		17.3			
WCC-11S		25.5			-
WCC-11M		11.1			
WCC-15D		60			
WCC-15S		49	·		
All Others		<1			

ORGANICS DETECTED IN ALL WELLS (ppb) (Continued)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
Bromoform					
A		18			
No.11		11.0			
No.12		2600			
WCC-6S	(1)	205			
WCC-11M		131			
WCC-11S		32			
WCC-15D		73			
WCC-15S		97			
All Others		<1			
Benzene				· · · · · · · · · · · · · · · · · · ·	
Α		4.5			
В	06			60	
DEP-1	10			0.6 J	
DEP-2	12			230	310
DW-5S					79
DW-7S					62
M-2		4.2			
M-3	20			22	
No.11		3.8			
No.12		655			
T-1			3		
WCC-5S		194			
WCC-6D	(4)	8.2			
WCC-6M	16			7	
WCC-6S	(2)	60			
WCC-6S	(1)	125			
WCC-11D		1.1			
WCC-11M		3.3			
WCC-11S	07	7.6		94	24
WCC-12M	8			320 J	120
WCC-15D		15.1			
WCC-15S	14	20.3		190	
All Others		<1		<5	
Toluene					
A		9.8			′
В	06			29	
C				6 B	
DEP-1	10			1 JB	
DEP-2	12			850 B	980
DW-5S					63

ORGANICS DETECTED IN ALL WELLS (ppb).

(Continued)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
DW-7D			1,32-1		22
MB		-		6	
M-2		5.7			`
M-3	20		-	6	
No.3			18		
No.3			19		
No.11		2.5			
No.12		2130			
PA-05				7 B	
Say-Pro A			11		
TB-3				1 JB	
WCC-3M		2.0			
WCC-5S		68			
WCC-6S	(1)	795			
WCC-6S	(2)	314			
WCC-7M	(-/	124			
WCC-11M		9.1			
WCC-11S	07	5.8		7	
WCC-12M	08			3000	290
WCC-15D		45			
WCC-15M	13			5	
WCC-15S	14	42		700	
All Others		<1		<5	
Bis(2-ethylhexyl)phthala	e				
MB		60			
No.19		32			
WCC-1D		36			
WCC-1M		22			
WCC-2M		43			
WCC-4M	7.5	43			
WCC-6D	(4)	27			<u> </u>
WCC-6S	(1)	42			
WCC-7M		37			
WCC-9D		24			
WCC-11S		175			
All Others	<u> </u>	<20			
1,2-Dichloropropane					
A		2.2			
В			3.8		
No.11		2.9			
No.12		375	10		

ORGANICS DETECTED IN ALL WELLS (ppb) (Continued)

Sampling Date:	#?	(Continu 3/82	5/85		11/14-16/88
Damping Date.	н:	3/02	5,05		11/14-10/00
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
WCC-1M		6.0			
WCC-5S		129			
WCC-6M	(3)	3.2			
WCC-6S	(1)	122			
WCC-6S	(2)	101			
WCC-7M		34			
WCC-11S		4.2			
WCC-15D		17.2			
WCC-15S		11.6	24		
All Others	,	<1			
٠.					
Chlorobenzene					
В	06		300	110	
DEP-2	12			290	460
DW-1S				·	22
DW-5D					59
DW-5S		•			290
DW-7D					580
M-3	20			17	
No.12		26.9	300		
WCC-6S	(2)	32			
WCC-6S	(1)	115			
WCC-7M		3.8			
WCC-11S	07	4.5		65	35
WCC-12M	08			900	1100
WCC-15D		3.9			
WCC-15S	14		100	580	
All Others		<1		<5	
Trans-1,2-Dichloroethyle	ene	06.4			
B	06	26.4		110	
DEP-1				110	
DEP-1	10 12			4 J	
M-3	20			46 J 30	
No.11	20	12.0		30	
No.12		925			
WCC-1M	01	323		32	
WCC-5S	VI	81		32	
WCC-6M	(2)	4.9		· · · · · · · · · · · · · · · · · · ·	
WCC-6S	(3)				
WCC-6S	(2)	26.3			
WCC-6S WCC-7M	(1)	185			
VVCC-/IVI		3.1			

ORGANICS DETECTED IN ALL WELLS (ppb)

(Continued)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
WCC-11D		2.5			
WCC-11M		23.0			
WCC-11S	07	31		24	
WCC-12M	8			1600	
WCC-15D		41			
WCC-15S		131			
All Others		<1		<5	
Ethylbenzene					
A		3.9			
В	06			22	
DEP-2	12			72 JB	87
DW-5D					10
DW-5S					26
DW-7S					40
M-2		17			
No.11		5.3			
No.12		330			
WCC-6S	(1)	60			
WCC-6S	(2)	82			
WCC-7M		5.4			
WCC-11M		6.0			
WCC-11S	07	6.4		16	
WCC-12M					50
WCC-15D		12.4			
WCC-15S	14	14.1		68	
All Others		<1		<5	
Total Xylenes	<u> </u>				
A		9.4			
M-2		10			
No.12		1190			
WCC-6S	(1)	185	<u> </u>		
WCC-6S	(2)	116			
WCC-7M		7.2	•		
WCC-11M		9.3	1		
WCC-11S		6.8			
WCC-15D		30			
WCC-15S		42			
All Others		<1			

ORGANICS DETECTED IN ALL WELLS (ppb) (Continued)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
1,1,1-Trichloroethane					
DW-6D					12
DW-6S					12
M-1		2.6			
M-2		3.7			
No.12		38			
TB-3				0.9 J	
WCC-6S	(1)	2200			
WCC-6S	(2)	56			
WCC-9D		2.7			
All Others		<1			
Trichloroethylene (Trichlo	roethene)				
A	05			72	
DEP-1	10	1		6	
DW-1D					10
DW-5D					38
DW-7S		-			59
M-2			•		14
M-2		20.3			
M-3	20			7	
M-6				•	80
No.11		2.3			+
No.12		1230			
T-1	19	1 :		47	
WCC-1M					19
WCC-1M	01			38	
WCC-6D	17			17	
WCC-6S	(1)	524			
WCC-9D	(1)	5.3			
WCC-9M	- 03			190	
WCC-11M	- 03	12.9		190	-
WCC-15M	13	12.9		17	
All Others	13	<1		<5	
Chrysene					
M-1		24			***
WCC-6S	(2)	24			- "
All Others	(4)	<20			
All Others		, \20			
1,3-Dichlorobenzene					
WCC-6S	(2)	21 *			
All Others		<20			

ORGANICS DETECTED IN ALL WELLS (ppb) (Continued)

Sampling Date:	#?	3/82	5/85		11/14–16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
1,4-Dichlorobenzene					
WCC-6S	(2)	21 *			
All Others		<20			
Hexachlorobenzene					
WCC-6S	(2)	53			
All Others		<20			
Hexachlorobutadiene	,				
No.12		182 ***			
WCC-6S	(2)	73			
All Others		<20			
N-nitrosodiphenylamine					
No.12		208			
WCC-6S	.(1)	471	, , ,		
WCC-6S	(2)	24			
All Others		<20			
Benzidene					
WCC-9D		34			
All Others		<20			
Dimethylphthalate					
WCC-11S		93			
WCC-6S	(1)	26	<u> </u>		
All Others		<20			
Bis(2-chloroethoxy)methat	ne				<u> </u>
No.12		41 **	† · · · · · · · · · · · · · · · · · · ·		
All Others		<20			·
Naphthalene					
No.12		41 **			
All Others		<20			
Nitrobenzene					
No.12		182 ***			
All Others		<20			

ORGANICS DETECTED IN ALL WELLS (ppb) (Continued)

		(Continued)		
Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
N-nitrosodi-n-propylar	nine		1		1
No.12		182 ***			
All Others		<20			
			'		
2-Chloronaphthalene					-
No.12		102			
All Others		<20			
Chloroform					-
DEP-1	10			4 J	
DEP-2	12			200 B	
FB-3	 			16	<u> </u>
No.3			1	10	
TB-1			<u> </u>	31	
TB-3				6 B	
T-1	<u> </u>		2	0 0	-
WCC-6S	(1)	1070			
All Others	+('/	<1	 	<5	
					
Acenaphthene					
WCC-6S	(1)	23	 		
All Others	1 (//	<20			
	-				
Acenaphthylene					
WCC-6S	(1)	46			
All Others	+(')	<20	<u> </u>		
All Othors		~20			
Hexachlorocyclopentad	iene				
No.12		125			
WCC-6S	(1)	184			1
All Others		<20			
Vinyl Chloride					
В	06		 	7 J	-
DW-7S			1.		11
WCC-11S	07		 	7 J	
All Others				<10	
Chloromethane					
WCC-15M	13	.	<u> </u>		-
All Others			<u> </u>	9 J	-
	-			<10	

ORGANICS DETECTED IN ALL WELLS (ppb)

(Continued)

		(Continu			T
Sampling Date:	#?	3/82	5/85		11/14–16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
Trichlorofluoromethane					
С				2 JB	
MB				2 J	
PA-05				3 JB	
1,2-Dichloroethene(Total)				
В			220		
DEP-2					48
DW-1D					10
DW-5D				· · · · · · · · · · · · · · · · · · ·	34
DW-7S					56
No.12			500		
WCC-12M					400
WCC-15S			1600		
All Others					<10
Tetrachloroethene					
DW-5D					18
DW-7S					. 24
All Others					<10
Trichloroethene					
В			48		
No.12			120		
T-1			33		
WCC-15S			340		
1,3-Dichloropropene	<u> </u>			-	
В			6		

Footnotes

*, **, and *** = Compounds elute at a similar retention time.

For 4-87 Data:

- < means that the compound was analyzed for but not detected at specified detection limit.
- B means the analyte was found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.
- J indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.

ORGANICS DETECTED IN ALL WELLS (ppb)

(Continued)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89

#? = Numbers not in parentheses are sample number qualifiers presented in the 4-87 data. Numbers in parentheses are sample number qualifiers presented in the 3-31-82 data. There is no indication as to what these numbers mean.
This table does not include Methylene Chloride or 1,1,2,2-Tetrachlorethane.

They are inlcuded in the table of the five constituents

APPENDIX A-4 INDEX TO MAPS ON FIGURE 1-5

INDEX TO MAP UNITS IN FIGURE 1.5. (CH2M HILL 1984)

ALSION SAND
Boonton loam, 2 to 5 percent slopes
Boonton loam, 5 to 10 percent slopes
Boonton loam, 10 to 15 percent slopes
Boonton-Urban land complex, 0 to 5 percent slopes
Chalfont silt loam, 0 to 2 percent slopes
Chalfont loam, 2 to 5 percent slopes
Downer loamy sand, 2 to 5 percent slopes
Downer loamy sand, 5 to 15 percent slopes
Downer sandy loam, 2 to 5 percent slopes
Downer-Urban land complex, 0 to 10 percent slopes
Downer-Urban land complex, 10 to 15 percent slopes
Dunellen-Urban land complex, 0 to 5 percent slopes
Dunellen Variant sandy loam, 0 to 2 percent slopes
Dunellen Variant sandy loam, 2 to 5 percent slopes
Dunellen Variant-Urban land complex, U to 5 percent slopes
Elkton loam
Ellington Variant sandy loam, 0 to 2 percent slopes
Ellington Variant sandy loam, 2 to 5 percent slopes
Ellington Variant-Urban land complex, 0 to 5 percent slopes
Evesboro sand, 0 to 5 percent slopes
Evesboro sand, 5 to 10 percent slopes
Evesboro sand, 10 to 15 percent slopes
Fallsington sandy loam
Fallsington loam
Fallsington Variant loam

INDEX TO MAP UNITS IN FIGURE 1.5. (CH2M HILL 1984)

FLR	Fort mott loamy sand, U to 5 percent
наА	Haledon silt loam, 0 to 2 percent slopes
HaB	Haledon silt loam, 2 to 5 percent slopes
HBB	Haledon-Urban land complex, 0 to 5 percent slopes
HcA	Haledon Variant silt loam, 0 to 2 percent slopes
HeA	Hammonton loamy sand, 0 to 3 percent slopes
HIA	Hammonton loamy sand, clayey substratum, 0 to 3 percent slopes.
HmA	Hammonton sandy loam, 0 to 2 percent slopes
НоА	Holmdel fine sandy loam, 0 to 2 percent slopes
HU	Humaquepts, frequently flooded
KeA	Keyport sandy loam, 0 to 2 percent slopes
KeB	Keyport sandy loam, 2 to 5 percent slopes
KeD	Keyport sandy loam, 10 to 15 percent slopes
KfA	Keyport loam, 0 to 2 percent slopes
KfC	Keyport loam, 5 to 10 percent slopes
KfD	Keyport loam, 10 to 15 percent slopes
KGB	Keyport-Urban land complex, 0 to 10 percent slopes
KIA	Klej loamy sand, 0 to 3 percent slopes
KmA	Klej loamy sand, clayey substratum, 0 to 3 percent slopes
KUA	Klej clayey substratum-Urban land complex,0 to 5 percent slopes
KvB	Klinesville shaly loam, 0 to 5 percent slopes
KVD	Klinesville shaly loam, 5 to 15 percent slopes
KVE	Klinesville shaly loam, 15 to 25 percent slopes
KWB	Klinesville-Urban land complex, 0 to 5 percent slopes

INDEX TO MAP UNITS IN FIGURE 1.5. (CH2M HILL 1984)

Lan	Lakendrist sand, o to 3 percent stopes
LeB	Lakewood sand, 2 to 8 percent slopes
LnA	Lansdowne silt loam, 0 to 2 percent slopes
LnB	Lansdowne silt loam, 2 to 5 percent slopes
LUA	Lansdowne silt loa, 2 to 5 percent slopes
LvA	Lansdowne Variant silt loam, 0 to 2 percent slopes
Ma	Manahawkin muck
4eA	Matapeake silt loam, 0 to 2 percent slopes
1eB	Matapeake silt loam, 2 to 5 percent slopes
1gA	Mattapex silt loam, 0 to 2 percent slopes
1gB	Mattapex silt loam, 2 to 5 percent slopes
4oA	Mount Lucas silt loam, 0 to 2 percent slopes
10B	Mount Lucas silt loam, 2 ro 5 percent slopes
1sB	Mount Lucas very stony silt loam, 0 to 5 percent slopes
1u	Mullica sandy loam
Aak	Nixon loam, O to 2 percent slopes
NaB	Nixon loam, 2 to 5 percent slopes
NCB	Nixon-Urban land complex, 0 to 5 percent slopes
NfA	Nixon Variant loam, U to 2 percent slopes
NfB	Nixon Variant loam, 2 to 5 percent slopes
NGA	Nixon Variant-Urban land complex, 0 to 5 percent slopes
a	Parsippany silt loam
Pb -	Parsippany silt loam, frequently flooded
)c	Parsippany Variant silt loan
-	

INDEX TO MAP UNITS IN FIGURE 1.5. (CH2M HILL 1984)

Pea	remberton loamy sand, 0 to 3 percent slopes
PfA	Penn silt loam, 0 to 2 percent slopes
PfB	Penn silt loam, 2 to 5 percent slopes
PhD	Phalanx loamy sand, 2 to 15 percent slopes
PL	Pits, clay
PM	Pits, sand and gravel
PN	Psamments, nearly level
PO	Psamments, sulfidic substratum
PW	Psamments, waste substratum
ReA	Reaville silt loam, 0 to 2 percent slopes
ReA	Reaville silt loam, 2 to 5 percent slopes
RFA	Reaville-Urban land complex, 0 to 5 percent slopes
Rh	Reaville Variant silt loam
Ro	Rowland silt loam
SaA	Sassafras sandy loam, 0 to 2 percent slopes
SaB	Sassafras sandy loam, 2 to 5 percent slopes
SaC	Sassafras sandy loam, 5 to 10 percent slopes
SgB	Sassafras gravelly sandy loam, 2 to 5 percent slopes
SgC	Sassafras gravelly sandy loam, 5 to 10 percent slopes
SyD	Sassafras gravelly sandy loam, 10 to 15 percent slopes
SIA	Sassafras loam, 0 to 2 percent slopes
SIB	
	Sassafras loam, 2 to 5 percent slopes
SMB	Sassafras-Urban land complex, 0 to 5 percent slopes
SrA	Shrewsbury sandy loam, 0 to 2 percent slopes

INDEX TO MAP UNITS IN FIGURE 1.5. (CH2M HILL 1984)

SU	Sulfaquents and sulfihemists, frequently flooded
TnB	Tinton loamy sand, U to 5 percent slopes
UB	Udorthenths, bedrock substratum
UC	Udorthents, clayey substratum
UD	Udorthents, wer substratum-Urban land complex
UL	Urban land
Wa	Watchung very stony silt loam, 0 to 2 percent slopes
MdA	Woodstown sandy loam, 0 to 2 percent slopes
WdB	Woodstown sandy loam, 2 to 5 percent slopes
WkA	Woodstown sandy loam, clayey substratum,0 to 2 percent slopes
kB	Woodstown sandy loan, clayey substratum, 2 to 5 percent slopes
AIA	Woodstown loam, 0 to 2 percent slopes
VIB	Woodstown loam, 2 to 5 percent slopes
1U .	Woodstown-Urban land complex, 0 to 5 percent slopes

APPENDIX A-5 WELL CONSTRUCTION INFORMATION

Well No.	Selected?	Source of Information	Total Well Depth	Estimated Elevation of Well Bottom	Screened Unit(s)	Land Surface Elevation	Top of Casing Elevation	Top of Screen (depth)	Bottom of Screen (depth)
A	Yes	W83/AD*/DM80							
8	Yes		51.5d/50 e	-27.14	Old Bridge		22.86 d		
		W83/AD*/DM80	52d/47.5 e	-22.51			24.99 d		
D		NSTRUCTION INFO							
	Yes	W83/AD*/DM80	52d/49.0 e	-21.64	Old Bridge	27.36c	29.16 d		
E / 1/2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Yes	W83/AD*/DM80	40d/40.0 e	-10.92			29.08 d		
·	Yes	AD*	58.0 e						
G	Yes	AD*/DM80	40.0 ⊖	-2.18	Old Bridge	37.82c		***	
H	Yes	AD*/DM80	36.0 ө	-9.26	Old Bridge	26.74c			
M-1	······································	DM80/W83	44.4 C	-19.97	Old Bridge	24.43 c	23.79 d		
M-2	Yes	W83/DM80/W89	37.9 b	-14.22	Old Bridge	22.75 c			
M-3		W83/DM80	45.6 c	-22.83	Old Bridge	22.77 c			
M-4		DM80	*****		Old Bridge		22.77 0		······································
M-5		DM80				· · · · · · · · · · · · · · · · · · ·			
M-6	Yes	W89	48.7 b				b		
S-1	Yes	W83/DM80	30 d	0.00	0115				* * * * * * * * * * * * * * * * * * * *
S-2	- 100	DM80	30.0	-6.68	Old Bridge	23.32c	23.32 d		
S-3	Yes	DM80	A 925 A 925 A 925 A				-		
<u> </u>	100	DMOU	25 c	2.05	Old Bridge	27.05c			
WCC-1M	Yes	W83/W89							
WCC-1D	Yes	M86.\M88.	55.1 b	-27.22			27.31d/27.88 b		
WCC-2M	Yes		101.25a/98.9 b	-71.13	Raritan	26 a	26.79d/27.77 b	91	101
WCC-3D	Yes	W86*/W89*	55.75a/57.21 b	-29.01	Raritan	24 a	26.34d/28.20 b	45/46	55/56
WCC-38	162	W86*/W89*	81a/80.25a/85.05 b	-55.57	Raritan	26 a	29.11d/29.48 b	71	81
WCC-3M		W83					27.63 d		
WCC-4M	Yes	W89	50.76 b	-22.37		·	28.39 b		
WCC-4D	Yes	W86*			Raritan			47	57
	Yes	W86*	80.16 a	-55.59		24 a	24.57 d		
WCC-48 WCC-5M		W83					24.25 d		
		W86*	35.75 a	-9.57	Raritan	26 a		25	35
WCC-58		W83					26.96 d		
WCC-6D	Yes	W86*/W89*	80a/80.5 a	-54.05	Raritan	25 a	25.95 d	65	75
WCC-69	Yes	W83/W89	37.7 b	-10.72			26.98d/26.35d/26.98 b		
WCC-6M	Yes	W83/W89	55.56 b	-29.41			26.15d/26.15 b	· · · · · · · · · · · · · · · · · · ·	
WCC-7M	Yes	W86*	55.10 a	-28.74	Raritan	25 a	26.36 d	45	55

Well No.	Selected?	Source of Information	Depth	Estimated Elevation of Well Bottom	Screened Unit(s)	Land Surface Elevation	Top of Casing Elevation	Top of Screen (depth)	Bottom of Screen (depth)
WCC-9M WCC-9S	Yes	W86*	55.5a/56.50 a	-31.55	Raritan	23 a	23.95 d	45	55
10000-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0	140 1454 0	W83					24.34 d		
WCC-9D		ONSTRUCTION INF							
WCC-11D	Yes	W86*/W89*	71.50 a	-48.29	Raritan	22 a	23.21 d	55	65
WCG-118	Yes	W83/W89	20.06 b	2.83			22.89d/22.89 b		
WCC-11M	Yes	W83/W89	51.88 b	-28.63			23.25d/23.25 b	·	
WCG-12M	Yes	W86*/W89*	56,50a/56.50 b	-33.67	Raritan	22 a	22.83d/22.83 b	45	55
WCC-13M	Yes	W86*/W89*	56.50a/55.88 b	-34.71	Raritan	19 a	1ft stkup/21.17 b	44	55
WCC-148		W83					20.39 d		
WCC-15M	Yes	W86*	51.50 a	-29.56	Raritan	21 a	21.94 d	38	40
WCC-158		W83					22.02 d		48
WCC-15D	NO WELL CO	NSTRUCTION INF	ORMATION				22.02 0		
WCC-16S	Yes	W83/W89	20.04 b	3.27			23.31d/23.31 b		
WE-1		W83*/W86*	25d	0.69		24a/25.69d	07.70 4		
WE-2		W83*/W86*	25d	-0.29		24a/25.690 24a/24.71d	27.72 d	23	25
WE-3	`	W83*	25d	2.11			26.93 d	23	25
WE-4	1	W83*	25d	-0.81		27.11d	29.01 d	23	25
				-0.81		24.19d	26.17 d	23	25
T-1		Con83							
T-2	NO WELL CO	NSTRUCTION INF	ORMATION						
T-3		NSTRUCTION INF							
Ala 4									
No.1		DM80							
No.2		DM80							
No.8	Yes	AD*/W86*	58e						
No.4	Yes	AD*/W86*	38+e			-			
No.5	Yes	AD*/W86*	54e						
No.6	NO WELL CO	NSTRUCTION INF	ORMATION				-		
No.7	NO WELL CO	NSTRUCTION INF	ORMATION						
No.8	NO WELL CO	NSTRUCTION INF	ORMATION						
No.9		AD*/W86*	57e/57.83 a	-39		18 a			
No.10	Yes	AD*/W86*	61e/71.00 a	-46		15 a		12.98	
No.11	Yes	AD*/DM80/W86*	52e/51.75 a	-34.08	Old Bridge	17.67c/17a		14.78	
No.12		DM80				12.07.04.174	15.98	14.78	
No.18	Yes	AD*/DM80/W86*	507e/60.63c/58.00 a	-40.37	Old Bridge	17.63c/17a	13.36	22c	32c

Well No.	Solucted?	Source of Information	Total Well Depth	Estimated Elevation of Well Bottom	Screened Unit(s)	Land Surface Elevation	Top of Casing Elevation	Top of Screen	Bottom of Screen
No.14	NO WELL CO	NSTRUCTION INF	ORMATION	12.44.63.413				(depth)	(depth)
No.15		NSTRUCTION INF		 					
No.16	Yes		71.7c	-53.32	S.Amboy Fire Clay	18.38c			
No.17		· · · · · · · · · · · · · · · · · · ·	62.7c	-42.7	Old Bridge	20.00c			
No.18	NO WELL CO	NSTRUCTION INF	ORMATION	1	Old Bridge	20.000			···
No.19	Yes		74.0c	-54	S.Amboy Fire Clay	20.00c			
No.20	NO WELL CO	NSTRUCTION INF	ORMATION		O.Alliboy Fire Clay	20.000			
No.21		NSTRUCTION INF							
No.22	NO WELL CO	VSTRUCTION INF	ORMATION						
Layne #1A	 	DM80	>200c	>-177	Farrington	23.00c			
Layne #1		DM80			· annigton	23.000			
Layne #2	1	DM80	>200c	>-180	Farrington	20.00c			
Layne #3		DM80			, annigion	20.000		· · · · · · · · · · · · · · · · · · ·	
Layne #4	Yes	DM80	70c	-50	Old Bridge	20.00c			
Layne #5		DM80				20.000			
Schoor #1	NO WELL CON	NSTRUCTION INF	ORMATION						
Schoor #2		DM80				·			
Schoor #3		DM80							·
Schoor #4		DM80			· · · · · · · · · · · · · · · · · · ·				
e de la companya de									
DEP-1	Yes	W89*	59.33 b	-34.67			24.66 b		
DEP-2	Yes	W89*	35.25 b	-10.87			24.38 b	50	60
DEP-3	NO WELL CON	ISTRUCTION INFO	DRMATION			:	24.36 D	24.2	36.5
DEP-4	Yes	W89*	27.6 b	-7.81			19.79 b	20	30
5.00 - 6	 								
DW-18	Yes	M89.	28.15 b	-5.47			20.68 b	14.52	24.52
DW-1D	Yes	W89*	56.35 b	-35.67			20.68 b	44.63	54.63
DW-28	Yes	W89*	,26.80 b	-4.6			22.20 b	14.75	24.75
DW-38	Yes	W89*	26.29 b	-2.32			23.97 b	14.32	24.73
DW-3D	Yes	W89*	56.48 b	-32.12			24.36 b	44.49	54.49
DW-48	Yes	W89*	27.0 b	0.51		-	27.51 b	15.41	25.41
DW-4D	Yes	W89*	58.27 b	-28.56			27.71 b	44.36	54.36
DW-5S	Yes	W89*	25.48 b	-2.69			22.79 b	13.87	23.87
DW-5D	Yes	W89*	52.26 b	-29.5			22.76 b	40.63	50.63

Well No.	Selected?	Source of Information	Depth	Estimated Elevation of Well Bottom	Screened Unit(s)	Land Surface Elevation	Top of Casing Elevation	Top of Screen (depth)	Bottom of Screen (depth)
DW-6S	Yes	W89*	26.78 b	-5.25			21.53 b	14.80	24.80
DW-6D	Yes	W89*	57.64 b	-36.31			21.33 b	45.68	55.68
DW-78	Yes	W89*	26.17 b	-3.26			22.91 b	14.62	24.62
DW-7D	Yes	W89*	53.54 b	-30.12			23.42 b	41.52	51.52

A B C D E F G	observation observation	11-74 11-74				Filter Pack	Material	Bent Seal	Grout	Material	Material	Material
C D E	observation		i			(depth)		(depth)	(depth)	j		
C D E F	observation		l	1			ſ					_
C D E		11-/4	 3*		sch40 PVC						concrete pad	sch40 PVC
D E F	observation		 3*		sch40 PVC			l			concrete pad	sch40 PVC
E	COSBIVATION	44.74	 									
F	observation	11-74	 3"		sch40 PVC						concrete pad	
***************************************	observation		 3*		sch40 PVC						concrete pad	sch40 PVC
· · · · · · · · · · · · · · · · · · ·	observation	11-74	 3*		sch40 PVC						concrete pad	sch40 PVC
H: The state of	observation	11-74	 3'	·	sch40 PVC						concrete pad	sch40 PVC
U. all desires	COSGIVATION	11-74	 3″		sch40 PVC						concrete pad	sch40 PVC
M-1	indust H2O sup?		 									
M-2	modot rizo adpi		 <u>-</u>						· .			
M-3			 									L
M-4			 									
M-5			 			· - · · · · · · · · · · · · · · · · · ·				<u> </u>		
M-6			 3*									
			 - 3								ļ	
S-1			 									
8-2	·		 		-	· ·					`	ļ
S-3	:		 							·		
			 						•			
WCC-1M			 									ļ
WCC-1D	monitoring	1-81	 2"	10	sch40 PVC							
WCC-2M	monitoring	1-81	2"		sch40 PVC	42						sch40 PVC
WCC-3D	monitoring	1-81	 2*		sch40 PVC		sand		surface	mud		sch40 PVC
WCC-3S			 		SCHOT VC							sch40 PVC
WCC-3M			 2"									<u> </u>
WCC-4M		1-81	 2"	10	sch40 PVC							
WCC-4D	monitoring		 		BUHUFYC							sch40 PVC
WCC-4S			 									ļ
WCC-5M	monitoring	1-81	 2"	10	sch40 PVC	22	9004					
WCC-59	•	 		'5	BUING F VO	- 22	sand		surface	heavy mud		sch40 PVC
WCC-6D	monitoring	1-81	 2"	10	sch40 PVC						·	
WCC-6S			 -+		20170 10		 -					sch40 PVC
WCC-6M		-	 									
WCC-7M	monitoring	1-81	 2"	10	sch40 PVC	40	sand		surface	thick mud		sch40 PVC

Well No.	Well Type	Date Installed	Drilling Method	Diameter	Screen Length	Screen Material	Top of Filter Pack (depth)	Filter Pack Material	Top of Bent Seal (depth)	Top of Grout (depth)	Grout Material	Surface Seal Material	Blank Material
WCC-9M	monitoring	4-81		2*	10	sch40 PVC	42	sand	T ,	2	heavy mud	concrete	sch40 PVC
WCC-9S	,												
WCC-9D													
WCC-11D	monitoring	4-81		2"	10	sch40 PVC	52	sand		2	heavy mud	cement	sch40 PVC
WCC-118							·-··		· · · · · · · · · · · · · · · · · · ·		,		
WCC-11M													
WCC-12M	monitoring	4-81		2"	10	sch40 PVC	42	sand		2	heavy mud	cement	sch40 PVC
WCG-13M	monitoring	4-81		2"		sch40 PVC	41	sand		2	heavy mud	concrete	sch40 PVC
WCC-149											mouty mou	00.10.00	00.110170
WCC-15M	monitoring	4-81		2"	10	sch40 PVC	34	sand		2	heavy mud	concrete?	sch40 PVC
WCC-158										·	······································	CO.I.O. C.C.	0011101110
WCC-15D													
WCC-16S													
WE-1		2-83	mud	1 1/4"	2'	PVC	21	sand	17	surface	Cemt Bent		PVC
WE-2		2-83	mud	1 1/4"	2'	PVC	21.5	sand	19	surface	Cemt Bent		PVC
WE-3			mud	1 1/4"	2'	PVC	20	sand	18	surface	Cemt Bent		PVC
WE-4				1 1/4"	2'	PVC	20	sand	18	surface	Cemt Bent		PVC
T-1	water supply												
T-2													
T-3													
47.	`												
No.1	Bennet Suction												
No.2	Bennet Suction												
No.3	Bennet Suction	1934		6″	15'								
No.4	Bennet Suction	pre-1934		10"	21'								
No.5	Bennet Suction	7–40		6″	15'					. 1			
No.6										1			
No.7													
No.8													
No.9	Bennet Suction	1912		6"	10'								
No.10	Bennet Suction	1911		8″	15'								
No.11	Bennet Suction	1911			15'								· · · · · · · · · · · · · · · · · · ·
No.12	Bennet Suction	L											
No.13	Bennet Suction	1911		6"	8"X10'								

Well No.	Well	Date	Drilling	Diameter	Screen	Screen	Top of	Filter Pack	Top of	Top of	Grout	Surface Seal	Blank
	Туре	Installed	Method		Length	Material	Filter Pack (depth)	Material	Bent Seal	Grout	Material	Material	Material
No.14	<u> </u>	Bestw. 2.861. 1844.		330 C S S N 5 S S S S S S S S S S S S S S S S	<u> </u>		(depti)	 	(depth)	(depth)			
No.15	· · · · · · · · · · · · · · · · · · ·		··		<u> </u>				 				
No.16	Bennet Suction	- 											
No.17	Bennet Suction		····									!	
No.18												 	
No.19	Bennet Suction										<u> </u>		
No.20													
No.21													
No.22											·····		
												· · · · · · · · · · · · · · · · · · ·	
Layne #1A													·
Layne #1													***************************************
Layne #2													
Layne #3													
Layne #4													
Layne #5					-							· · · · · · · · · · · · · · · · · · ·	
Schoor #1						· · · · · · · · · · · · · · · · · · ·					11. J		
Schoor #2													
Schoor #3													
Schoor #4												·	
DEP-1		10-82	HSA	2"		20slot PVC							PVC
DEP-2	monitoring	10-82	HSA	2"	12.3	20slot PVC							PVC
DEP-3								-					
DEP-4		10-82	HSA	2"	10	20slot PVC							PVC
DW-18	monitoring	?	HSA	2"	10	PVC	12	sand	10	5	cemt bent	cement	PVC
DW-1D	monitoring	10-88		2"	10	PVC	40	sand	38	5	cemt bent	cement	PVC
DW-28	monitoring	10-88		2"	10	PVC	11.5	sand	10	4	cemt bent	cement	PVC
DW-38	monitoring	1088	HSA	4"	10	PVC	12	sand	10	5	cemt bent	cement	PVC
DW-3D	monitoring	10-88		4"	10	PVC	42	sand	40	5	cemt bent	cement	PVC
DW-48	monitoring	11-88	HSA	2"	10	PVC	12.3	sand	10.3	4	cemt bent	cement	PVC
DW-4D	monitoring	11-88		2"	10	PVC	40	sand	37	4	cemt bent	cement	PVC
DW-58	monitoring	10-88	HSA	2"	10	PVC	11.8	sand	9.8	4	cemt bent	cement	PVC
DW-5D	monitoring	10-88		2"	10	PVC	35.7	sand	33.8	4	cemt bent	cement	PVC

,													
Well No.	Well Type	Date Installed	Drilling Method	Diameter	Screen Length	Screen Material	Top of Filter Pack	Filter Pack Material	Bent Seal	Top of Grout	Grout Material	Surface Seal Material	Blank Material
DW-6S	monitoring	10-88	HSA	2"	10	BVC	(depth)	<u> </u>	(depth)	(depth)			
DW-6D	monitoring		1104			PVC	12	sand	9	4.5	cemt bent	cement	PVC
		10-88		2"	10	PVC	42	sand	40	4	cemt bent	cement	PVC
DW-78	monitoring	10-88		2"	10	PVC	11.5	sand	8.8	<u>·</u>		·	
DW-70	monitoring	10-88		2#						4	cemt bent	cement	PVC
	·······································	.0-00	L		10	PVC	38	sand	35	4	cemt bent	cement	PVC

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Well No.	Comment
A	Also called "AD-" and "PA-"
В	Also called "AD-" and "PA-"
C	
C D E F	Also called "AD-" and "PA-"
E	Also called "AD-" and "PA-"
F	
G H	
Н	
M-1	Also called "MI-"
M-2	Also called "MI-"
M-3	Also called "MI-"
M-4	Also called "MI"
M-5	Also called "MI"
M-6	Also called "MI-"
S-1	
S-2	
S-3	
WCC-1M	
WCC-1D	
WCC-2M	Also called WCC-2
WCC-3D	
WCC-3S	
WCC-3M	
WCC-4M	See note at bottom of table.
WCC-4D	See note at bottom of table.
WCC-48	
WCC-5M	
WCC-5S	
WCC-6D	
WCC-68	
WCC-6M	
WCC-7M	

Well No.	Comment				
WCC-9M					
WCC-99					
WCC-9D	,				
WCC-11D					
WCC-118	Also called WCC-11VS				
WCG-11M					
WCC-12M					
WCC-13M					
WCC-148					
WCC-15M	Well Depth reported for "WCC-15", assummed to be WCC-15M				
WCC-159					
WCC-15D					
WCC-16S	Also called WCC-16VS				
WE-1	pumped 125-150 gals to develop				
WE-2	pumped 125-150 gals to develop				
WE-3	pumped 125-150 gals to develop				
WE-4	pumped 125-150 gals to develop				
T-1	Also called MI-T-1, M1-T1, or MI-T1				
T-2					
T-3					
No.1					
No.2					
No.4	shut down 2/72, 6/73				
	shut down 12/1/70				
No.5 No.6	shut down 2/72, 6/73				
No.7					
No.8					
No.9	shut down 2/72, 6/73, Also B-9				
No.10	shut down 2/72, 6/73, Also B-9 shut down 2/72, 6/73, Also B-10				
No.11	shut down 2/72, 6/73, Also B-10				
No.12	SHUL GOWN 212, 013, AISO D-11				
No.13	shut down 2/72, 6/73, Also B-13				
170.10	31101 OOWII 21 2, 01/3, NISU 5-13				

Well No.	Comment				
No.14					
No.15					
No.16	poss. also screened in Old Bridge				
No.17	poss. also screened in Old Bridge				
No.18					
No.19	poss. also screened in Old Bridge				
No.20	Para and derionida in Old Bridge				
No.21					
No.22					
1,334					
Layne #1A					
Layne #1					
Layne #2					
Layne #3					
Layne #4					
Layne #5					
Schoor #1	Also called SE-1				
Schoor #2	Also called SE-2				
Schoor #3	Also called SE-3				
Schoor #4	Also called SE-4				
DEP-1	Also called ST-1				
DEP-2	Also called ST-2				
DEP-3					
DEP-4	Also called ST-4				
DW 10					
DW-18 DW-1D	developed by centrifugal pump for at least 2 hours				
DW-28	developed by centrifugal pump for at least 2 hours				
DW-25	developed by centrifugal pump for at least 2 hours				
DW-3D	developed by centrifugal pump for at least 2 hours				
DW-48	developed by centrifugal pump for at least 2 hours				
DW-4D	developed by centrifugal pump for at least 2 hours				
DW-63	developed by centrifugal pump for at least 2 hours				
DW-6D	developed by contrifugal pump for at least 2 hours				
	developed by centrifugal pump for at least 2 hours				

Well No.	Comment		
DW-65	developed by centrifugal pump for at least 2 hours		
DW-6D	developed by centrifugal pump for at least 2 hours		
DW-78	developed by centrifugal pump for at least 2 hours		
DW-7D	developed by centrifugal pump for at least 2 hours		

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NOTES:

- (1) Table contains information specifically presented in available documents.
- (2) All elevations and depths are in feet.
- (3) A 'Yes' in the 'Selected' column indicates that the well is listed in the table presented as Appendix A.9.
- (4) Well Survey Coordinates were not available for any wells.
- (5) Additional well depth and top of casing information received from NJDEP on 6-9-89 could not be incorporated into this Draft FS.
- * Reference includes well log. Log for WCC-4X (Wehran 1986) is identified as both WCC-4M and WCC-4D. Professional judgement used to differentiate well log information for Wells WCC-4M and WCC-4D.
 - Logs for WE-1 and WE-2 given in Wehran 1986 are for test borings (grouted). Well construction logs given in Wehran 1983.
- a = Wehran 1986. Ground surface elevation is plus or minus two feet.
- = Wehren 1989. Note: Total Well Depth = Depth of well below top of protective casing.
- c = Dames and Moore 1980. Well depths estimated from cross sections.
- d = Wehren 1983
- e = Ad-Tek 1975
- ? = Data illegible or otherwise questionable
- AD = Ad-Tek 1975
- DM80 = Dames and Moore 1980
- Con83 = Converse Consultants 1983
- W83 = Wehran 1983
- W86 = Wehran 1986
- W89 = Wehran 1989

APPENDIX A-6 WELL LOGS AND WELL RECORDS

USEABLE WELL LIST

Well	Total Depth (feet)	Screen Depth (feet)	Unit	Detected Values
Ā	51.5/50	NA	ОВ	YES
В	52/47.5	NA	OB	YES
D	52/49.0	NA	ОВ	YES
E	40	NA	OB	YES
F	58.0	NA	OB	YES
G	40.0	NA	ОВ	YES
Н	36.0	NA	ОВ	YES
S-1	30.0	NA	OB	YES
S-3	25.0	NA	OB	YES
WCC-1M				YES
WCC-1D	101.25	91 - 101	OB	YES
WCC-2M	55.75	45/46 - 55/56	OB	YES
WCC-3M				YES
WCC-3D	81/80.25	71 - 81	OB	YES
WCC-4M(D)	80.16	47 - 57	ОВ	YES
WCC-6S				YES
WCC-6M				YES
WCC-6D	80/80.5	65 - 75	OB	YES
WCC-7M	55.1	45 - 55	ОВ	YES
WCC-9M	55.5/56.5	45 - 55	ов	YES
WCC-11S				YES
WCC-11M		-		YES
WCC-11D	71.5	55 - 65	ов	YES
WCC-12M	56.5	45 - 55	ОВ	YES
WCC-13M	56.5	44 - 54	ОВ	YES
WCC-15M	51.5	38 - 48	ОВ	YES
WCC-16S				YES
NO.3	58	NA	ОВ	YES
NO.4	38+	NA	OB	YES
NO.5	54	NA	OB ·	YES
NO.10	61/71	NA	OB/SA	YES
NO.11	52/51.75	NA	OB	YES
NO.13	50/60.63/58	NA	OB	YES
NO.16	71.7	NA	OB/SA	YES
NO.19	74.0	NA	OB/SA	YES
L-4	70	NA	OB	YES
M-2	70	****	•	YES
M-6				YES
DEP-1			•	YES
DEP-2	•			YES
DEP-4				YES
DW-1S			•	YES
DW-15 DW-1D				YES
DW-1D DW-2S				YES.
DW-25				YES
DW-3D				YES
				YES
DW-4S				IES

DW-4D DW-5S DW-5D DW-6S DW-6D DW-7S	YES YES YES YES YES YES YES
DW-7D	YES

NA = not available

OB = Old Bridge Aquifer SA = South Amboy Fire Clay

one or more of the five constituents of Detected Values = concern were detected in samples collected from the well

SOURCE: AD-TEK 1975

CASING IN GROUND 111-6 BORING NO. BORINGS BY CASING INSTALLED 14'-0 TECHNICAL TESTING CO DATE 4-3-73 SOIL SAMPLING 2'-0 ELEVATION NAS DEPTH-F1 SAMPLE DEPTH OF SAMPLER DESCRIPTION OF STRATA CASING STRATA BLOWS/6" BLOWS/1' 0'-0" 2. 5 3. 7 10 5 ઉ 20 5.3 **ώ** 0 3 64 9 10 59 Bottom of Installed Casing 50 1 11 11'-6" 42/6" Brown M-C SAND, Trace GRAVEI NOT RECORDED 1 13'-6" Trace SILT Sampling Operation .. Terminated At 13'-6" Location Within the Madison Township Sewerage Authority Easement north east of Jernees Mill Road and north west of Old Water Works Road. A-55

TECHNICAL TESTING INC

. CASING INSTALLATION 73-54/So-939

BORING NO.

DATE 4-3-73

2

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ELEVATION

BORINGS BY TECHNICAL TESTING CO CASING INSTALLED 14'-0"

CASING IN GROUND 11'-6"

SOIL SAMPLING

DEPTH OF CASING SAMPLER DESCRIPTION OF STRATA STRATA BLOWS/6" BLOWS/1 0'-0" 0 7 2 S 3 10 15 5 35 ઇ 33 ÷7 કે 50 9 110 5 S 111 | 73 11'-6" Bottom of Installed Casing 48/6" Light Brown F-M SAND, Trace NOT RECORDED 13'-6" GRAVEL, Trace SILT 1 24 Sampling Operation Terminated At 13'-6" Location Within the Madison Township Sewerage Authority Easement, approximately three feet north east of the manhole at the intersection of Runyon-Cheesequake Rd. and Old Water Works Road.

CASING INSTALLATION 73-54/S0-939

BORING NO. CASING IN GROUND 10'-0" BORINGS BY CASING INSTALLED 13'-0" DATE 4-4-73 TUCHNICAL TESTING CO. SOIL SAMPLING 2'-0" ELEVATION NA 8 DEPTH-FT SAMPLE SAMPLE DEPTH OF SAMPLER CASING DESCRIPTION OF STRATA STRATA BLOWS/6" BLOWS/1 0'-0" 0 11 1 21 2 34 3 51 4 **ΰ** 3 5 73 6 96 109 3 9 183 10'-0" Bottom of Installed Casing 110 Brown F-M SAND, Trace GRAVEL, 111 NOT RECORDED Trace SILT 12! - 0". Sampling Operation Terminated At 12'-0" Location Within the Madison Township Sewerage Authority Easement, approximately 2500 feet north east of the intersection of Jernees Mill Road and Old Water Works Road. A-57

BORING NO. BORINGS BY Gensing in Ground 81-6" 4-6-73 DATE TECHNICAL TESTING CO CASING INSTALLED 10'-5" ::A ELEVATION SOIL SAMPLING 2'-0" SAMPLE NO CASING -- SAMPLER . DEPTH OF DESCRIPTION OF STRATA BLOWS/: BLOWS/6" STRATA 0 0'-0" 23 47 3 81 96 5 135 б <u>6'-0"</u> Bottom of Installed Casing Brown M-C SAND, Trace GRAVEL, NOT RECORDED 1 8'-0" Trace SILT Sampling Operation Terminated At 8'-0" Location Within the Madison Township Sewerage Authority Easement adjacent to the Food Additives Plant property. A-58

TECHNICAL TESTING INC.

73-54/80-939

ADTEK ENGINEERING, INC. P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy

Pricketts Brook Watershed-Observation Wells

Boring No: Well A

Date: 11/7/74

Comments: Installed 3" I.D.

PVC Sched. 40 Plastic

Pipe to 50.0'

Casing Hammer

Wt. 300# Fall 24"

Sampler Hammer

Wt. 140# Fall 30"

Casing I.D.

Sampler 0.D.

Classification of Materials

F - Fine 35-50% And

Some 20-35% M - Medium

10-20% Little C - Course

0-10% Trace

Strata Changes (ft.) Description

Dark grey M-F sand; Tr. silt, Tr. roots Lt. grey M-F sand; Tr. silt; Tr. Veg. 0.3-0.5 0.5 - 3.0

Mottled yellow, Red-Brn C-M-F sand; some 3.0-9.0

C-M-F Quartzite gravel; Tr. silt

Yell-Brn. C-M-F sand; Tr. silt Yell-Brn. C-M-F sand; Tr. silt Lite grey(streaks of Yell) silt; 9.0-15.0 15.0-25.0

25.0-29.0

Little clay; Tr. F sand & clay occurs in

laminations

Grey clayey-silt-partings F sand 29.0-34.0

Grey C-M-F sand; Tr. silt 34.0-40.0

Grey (streaks of Yell) C-M-F sand 40.0-50.0

Little silt; Tr. clay; Tr.lignite

Bottom of Boring 50.01

ADTEK ENGINEERING, INC. P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

roject: City of Perth Amboy

Pricketts Brook Watershed-Observation Wells

Boring No: Well B Date: 11/11/74

Comments: Installed 3" I.D.

Perf'd PVC Sched: 40

Plastic Pipe to 47.51

Casing Hammer Wt. 300# Fall 24"

Sampler Hammer Wt. 140# Fall 30" Casing I.D. 2 1/2"

Sampler O.D. 2"

Classification of Materials

F - Fine

A - Medium

C - Course

And 35-50% Some 20-35%

Little 10-20% Trace 0-10%

itrata Changes (ft)

3.0-3.5

3.5-5.0 3.0-10.0

10.0-13.0

13.0-25.0

5.0-35.0

40.6

0.0-52.0

2.0

Description

Dk. grey M-F sand; Tr.silt; Tr. Veg. Dk. yell-Brn. M-F sand; Tr. silt Grey C-M-F sand; Tr. silt *encountered grd. water @ 5' Grey C-M-F sand; Tr. silt; Tr. lignite Grey C-M-F sand; Tr. silt; Mote:Extremely fast running sand & 17.0'-20.0' prohibit proper cleaning out casing-jarred "wash" sample Grey C-M-F sand; Tr. silt; layers (Approx. 6-3') grey-Brn silt and clay Lite grey C-M-F sand; Tr. silt; Tr. lignite; partings grey clay Lite grey C-M-F sand; Tr. silt Bottom of boring

ADTEK ENGINEERING, INC. P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy
Pricketts Brook Watershed-Observation Wells

Boring No: D
Date: 11/22/74

Comments: Installed 3" I.D.

PVC Sched. 40 Plastic Pipe to 49.0'

Casing Hammer Wt. 300# Fall 24"

Sampler Hammer
Wt. 140# Fall 30"
Casing I.D. 4"
Sampler O.D. 2"

Classification of Materials

F - Fine M - Medium C - Course And 35-50% Some 20-35% Little 10-20% Trace 0-10%

Strata Changes (ft.)

0.0-10.0

20.0-31.0 31.0-35.0

35.0-40.0

45.0-52.0

52.0 .

Description

No samples taken
Orange & yell. C-M-F sand; Little clayer-silt;
Trace F gravel
Yell, grey & orange C-M-F sand; tr. silt
Grey & Grange-Brn M-F sand; Little clayey-silt
Grey M-F sand; Little clayey-silt; Tr. lignite
Mottled yellow & grey M-F sand; Little clayeysilt; trace lignite; trace mica flakes
Grey & yellow C-M-F sand; Trace silt
Bottom of Boring

ADTEK ENGINEERING, INC. P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy

Pricketts Brook Watershed-Observation Wells

Boring No: E Date: 11/21/74

Comments: Installed 3" I.D.

PVC Sched. 40 Plastic

Pipe to 40'

Casing Hammer Wt. 300# Fall 24"

Sampler Hammer Wt. 140# Fall 30" Casing I.D. 4"

Sampler 0.D. 2"

Classification of Materials

F- Fine M - Medium

C - Course

And 35-50% Some 23-35% Little 10-20% Trace 0-10%

Strata Changes (Ft.)

0.0-10.0 10.0-20.0

20.0-30.0 30.0-31.0

31.0-31.5

31.5-40.0 40.01

Description

No samples taken Orange & yellow C-M-F sand; little C-M-F Quartzite gravel; trace silt Grey & Yellow M-F sand; little clayey-silt Grey, Yell, Orng.X-F sand; Tr. silt Layer lite grey silt and clay; Tr. F sand Resume grey, yell, orange M-F sand; Tr.silt Bottom of boring

ADTEK ENGINEERING, INC. P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy

Pricketts Brook Watershed-Observation Wells

Boring No: F Date: 11/14/74

Comments: Installed 3" I.D.

PVC Sched. 40 Plastic

Pipe to 58.0'

Casing Hammer %t. 300% Fall 24"

Sampler Hammer Wt. 140% Fall 30"

Casing I.D. 4"
Sampler O.D. 2"

Classification of Materials

F - Fine M - Medium

C - Course

And 35-50% Some 20-35% Little 10-20% Trace 0-10%

Strata Changes (ft.)

Description

0.0-3.0 3.0-10.3

10.0-15.0

15.0-19.0

19.0-29.0

29.0-40.0

40.0-43.0

3-61.0

61.0

.

l" cracked stone, cinders, sand (fill)

Yellow-Brn M-F sand; trace silt

Yell-(tr ornage) M-F sand; Tr silt;

Tr F Quartzite gravel

Yellow C-M-F sand; Tr silt

Mottled orgn, yell, red M-F sand; tr silt

Orange-Brn C-M-F sand; Tr silt

Lite yellow (tr. red) C-M-F sand; tr. silt

Grey M-F sand; Little Clayey-silt Tr. lignite. Grey & yell M-F sand; Trace clayey-silt

bottom of Boring

ADTEK ENGINEERING, INC. P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy

Pricketts Brook Watershed-Observation Wells

Boring: G

Date: 11/15/74

Comments: Installed 3" I.D.

PVC Sched. 40 plastic

pipe to 40.0'

Casing Hammer

300≈ Wt. Fall 24"

Sampler Hammer

Wt. 140# Fall 30"
Casing I.D. 4"

Sampler O.D. 2"

Classification of Materials

F - Fine M - Medium

C - Course

And 35-50% Some 20-35% Little 10-20%

Strata Changes (ft.)

0.0-10.0

10.0-20.0

20.0-41.5

41.5-42.0

42.0

Description

Trace

Miscell. fill (sand, Cond., Trees)

No samples taken 0-10'

Grey M-F sand; Trace silt

Orange & yellow C-M-F Sand; Trace silt

Yellow & red clayey-silt; Tr F sand

Bottom of boring

ADTEK ENGINEERING, INC. P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy

Pricketts Brook Watershed-Observation Wells

Boring: H

Date: 11/13/74

Comments: Installed 3" I.D.

PVC Sched. 40 plastic pipe to 36.0'

Casing Hammer

300# fall 24"

Sampler Hammer

140# Wt. Fall Casing I.D. 4"

30"

Sampler O.D.

Classification of Materials

F - Fine

X - Medium

C - Course

And 35-50%

Some 20-35%

Little 10-20% Trace 0-10%

Strata Changes (ft.)

0.0-10.0

10.0-20.0 20.0-33.3

38.0-39.0

39.0

Description

No samples taken 0-10:

Grey & Yellow C-M-F sand; tr silt

Yellow C-M-F sand; Tr silt; Tr F Quartzite

gravel

Yellow C-M-F sand; Tr silt; Trace Clay (small

"pockets"); trace wood

bottom of boring

PERTH AMEDY SUCTION WELLS

No. 3 Existing- size 6", depth 58', s.s.screen 15'

```
0-10 Yellow to light sand
                                               Installed 1934
L0g:
       10-23 Yellow to light gray sand
                                              Replaced 1963
       23-29 clay
                                              Installed submersible
        29-30 Hard pan
                                              bump to sewer - 3/73
        30- 58'10" Coarse gray water sand
                                              State order shut-downs
                                              2/72, 6/73
         Existing- size 6", depth 54', s.s.screen 15'
No 5
                                              Installed 7/16/40
       0-10 Yellow to light sand
Log:
      10-23 Yellow to light gray sand
                                              Replaced 4/26/63
       23-29 clay
29-30 Hard pand
                                              Shut-downs- 2/72, 6/73
       30- 53' 10" coarse gray water sand clay
       58'10" - clar
No. 9 Existing- size 6", depth 57', s.s.sceeen 10'
                                               Installed 1912
        0-10 light yellow sand
LOg
                                              Replaced- 7/40,6/48,11/53
        10-23 light gray sand
       23-30 clay with small portion gravel Shut-downs-2/72, 6/73
        30- 57' 10" gray water sand
        57' 10" - clay
No. 10 Existing- size 8", depth 61', s.s.screen 15'
                                               Installed 1911
Log:
       0 -10 Brown sand and gravel
       10-42 Lt. Brn. sand streaks white clay Replaced 7/26,1957,1963
_ - -
                                              Shut-downs-2/72,6/73
       42-47 white - yellow clay
       47-65 Fine to coarse lt. brown sand
       65-71 White sandy clay
No. 11 Existing- size 6", depth 52', s.s.screen 15'
                                               Installed 1911
Log: 0-13 Dirty yellow sand
                                               Replaced 1952, 1963
       13-15 Gray sand
                                               Shut-downs 2/72, 6/73
       15-19 gray clay
       19-27 Brown sand - gravel
                                                      Water Sample 1/1/63
       27-40 gray sand
                                              Tot.Sol.
                                                                  166.
                                                                        222
       40-41 gray clay
41-46 Brown sand
                                              COgHard.
                                                                    5.5
                                               Non-CO3
                                                                   32.5
       46- 51' 8" gray clay
                                               Tot.Hard.
                                                                   33.0
                                               Ca Hard.
                                                                   26.0
                                               Chloride:
                                                                    5.0
                                 A-66
                                               Alk.M.O.
                                               Free Carb.Acid(CO<sub>2</sub>) 69.5
```

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1.7

PERTH AMBOY SUCTION WELLS

No. 13 Existing- size 6", depth 50'?, s.s.screen 8"x10'

0-6 Topsoil & sand LOg:

6-9 Gravel & sand

9-11 sand 11-18 sand, clay & gravel 18-21 sand, wood & clay

21-26 sand

26-28 sand & clay balls

28-35 sand pyrite & clay

35-40 coarse sand

40-50 coarse sand & clay balls

Brn. sand & clay balls 50-54

54-58 muddy sand & clay

Existing- size 10", depth 38'+ screen L=21'

NO LOG

Installed 1911 Replaced- 1/2/51, 6/27/57 Shut-down 2/72, 6/73

Installed prior to 1934 Replaced- 1934, 1940

12/1/70- Filled with iron & fibrous white jelly. Sounded to 38'-6" & shut down.

```
No. 3 Existing- size 6", depth 58', s.s.screen 15'
 LOg:
        0-10 Yellow to light sand
                                              Installed 1934
        10-23 Yellow to light gray sand
                                              Replaced 1963
        23-29 clay
                                              Installed submersible
        29-30 Hard pan
                                              pump to sewer - 3/73
        30- 58'10" Coarse gray water sand
                                              State order shut-downs
                                              2/72, 6/73
No 5 Existing- size 6", depth 54', s.s.screen 15'
Log: 0-10 Yellow to light sand
                                             Installed 7/16/40
      10-23 Yellow to light gray sand
                                             Replaced 4/26/63
       23-29 clay
                                             Shut-downs- 2/72, 6/73
       29-30 Hard pand
30-53'10" coa
                   coarse gray water sand clay
       58'10" - clay
No. 9 Existing- size 6", depth 57', s.s.screen 10'
        0-10 light yellow sand
LOg
                                             Installed 1912
       10-23 light gray sand
                                             Replaced- 7/40,6/48,11/53
       23-30 clay with small portion gravel Shut-downs-2/72, 6/73
       30- 57' 10" gray water sand
        57' 10" - clay
No. 10 Existing- size 8", depth 61', s.s.screen 15'
       0 -10 Brown sand and gravel
Log:
                                             Installed 1911
       10-42 Lt. Brn. sand streaks white clay Replaced 7/26,1957,1963
       42-47 white - yellow clay
                                             Shut-downs-2/72,6/73
       47-65 Fine to coarse lt. brown sand
       65-71 White sandy clay
No. 11 Existing- size 6", depth 52', s.s.screen 15'
Log: 0-13 Dirty yellow sand
                                             Installed 1911
       13-15 Gray sand
                                             Replaced 1952, 1963
       15-19 gray clay
                                             Shut-downs 2/72, 6/73
       19-27 Brown sand - gravel
                                                    Water Sample 1/1/63
       27-40 gray sand
                                             Tot.Sol.
                                                                166
       40-41 gray clay
                                             COgHard.
                                                                  5.5
       41-46
              Brown sand
                                             Non-CO3
                                                                 32.5
```

46- 51' 8" gray clay

A-68 Alk.M.O. Free Carb.Acid(CO₂) 69.3

Tot.Hard.

Ca Hard.

Chloride.

33.0

26.0

SOURCE: WEHRAN 1983

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SOURCE: CONVERSE 1984

IDENTIFICATION TUBE PER 12"  A. Black Organic Silt, very soft  B. do  C. Black Sand w/ layers Organic Silt  D. Black Peat & Organic Silt  A. Black Organic Silt  D. Black Peat & Organic Silt  Tube: 0-4.0' Rec.=24" Push  A. Black Organic Silt  Tube: 4.0'-7. Rec.=36"			nsultants,	[		TEST E		-	-	ВС	DRING NO. B-
BORING CONTACTOR Warren George  GROUND WATER  DATE  TIME  DEPTH  CASING TYPE  F.J.  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 4"  DIAL 54"  CWOD REP. KJL  CWOD REP. KJL  CWOD REP. KJL  A. Black Organic Silt, very soft  D. Black Peat & Organic Silt  PH=6.5, pond Tube: 0-4.0'  Tube: 0-4.0'  Rec.=24"  Push  A. Black Organic Silt  Tube: 4.0'-7.  Rec.=36"	PROJECT	Prickett	's Pond	Sampling	Old B	ridge.	New Jer	sey		SH	T. NO. 1 OF 1
CAS. SAMP. CORE TUBE DATUM  DATE TIME DEPTH CASING TYPE F.J. SHELBY DATE START 03/08/  DIA 4" 3" DATE FINISH 03/08/  WT. 140# 140# ORILERR. Daniel  EL 250 ON TUBE PER 12" DEPTH CASING TYPE F.J. SHELBY DATE START 03/08/  FALL 24" 24" CWOD REP. KJL  EL 250 ON TUBE PER 12" DEPTH CASING TYPE F.J. SHELBY DATE START 03/08/  IDENTIFICATION REMARK  2.0' Water  A. Black Organic Silt, very soft  D. Black Peat & Organic Silt  PH=6.5, pond of Tube: 0-4.0' Rec.=24"  Push  A. Black Organic Silt  Tube: 4.0'-7.  Rec.=36"	BORING C	adison/C Ontractor	PS Indus	tries George						PR	OJ. NO.81-07188
DATE TIME DEPTH CASING TYPE F.J. SHELBY DATE START 03/08/ DIA. 4" 3" DATE FINISH 03/08/ WT. 140# 140# ORILLERR. Daniel FALL 24" 24" CWDO REP. KJL  BLOWS ON TUBE PER 12" A. Black Organic Silt, very soft  C. Black Sand w/ Layers Organic Silt  B. do  C. Black Peat & Organic Silt  D. Black Peat & Organic Silt  A. Black Organic Silt  Tube: 0-4.0' Rec.=24" Push  Tube: 4.0'-7. Rec.=36"	GROUND V	VATER	- Harren	DEDITE		CAS.	SAMP.	CORE	TURE		
WT. 140# 140# ORILLERR. Daniel  BLOWS ON TUBE PER 12"  A. Black Organic Silt, very soft  B. do  C. Black Sand w/ layers Organic Silt  D. Black Peat & Organic Silt  A. Black Organic Silt  D. Black Peat & Organic Silt  A. Black Organic Silt  Tube: 0-4.0'  Rec.=24"  Push  Tube: 4.0'-7.  Rec.=36"	DATE	TIME	DEPTH	CASING	<del></del>						
S-1.    Shows on Tube   Fall   24"   24"   CWOOREP. KJL									3"	DA.	TE FINISH 03/08/
Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve Solve				<del>-</del>				<del> </del>		DRI	LLERR. Daniel
B. do  C. Black Sand w/ layers Organic Silt  pH=6.5, pond Tube: 0-4.0' Rec.=24"  Push  A. Black Organic Silt  Tube: 4.0'-7, Rec.=36"	CASING BLOWS	SAMPLE NO.	ON TUBE PER 12"			IDENTI		ON	124	10	REMARK
5 Push a nammer	3 4	S-1.		B. do C. B1 D. B1	ack Sar ack Pea	id w/ 1:	ayers O	rganic	Silt		Rec.=24" Push Tube: 4.0'-7.
	-	<u> </u>							5.	51	•
5.51	. L		E	D. Gra	y Sand	, occas	ional g	ravel			
D. Gray Sand, occasional gravel		S-2	88.	E. do				Ň.			
6	<b>  </b>	<b> </b>			,						
S-2 E. do			7.	F. Tar	Sand,	medium	fine				•
6	1						END	OF BORI	NG @ 7.	해	
S-2 E. do	$\vdash$	<u> </u>									•
S-2 E. do F. Tan Sand, medium fine						•					
F. Tan Sand, medium fine  END OF BORING @ 7.0'	1										
S-2 E. do F. Tan Sand, medium fine		}								1,	m calthumbia
E. do  F. Tan Sand, medium fine  END OF BORING @ 7.0'									•		
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E. do  F. Tan Sand, medium fine  END OF BORING @ 7.0'  On calibration pH meter measurements.			1 1							ı	
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F. Tan Sand, medium fine  END OF BORING @ 7.0'  On calibration pH meter measu						•			•		
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E. do  F. Tan Sand, medium fine  END OF BORING @ 7.0'  On calibration pH meter measu 7.8 instead of				• .		A-82					

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				ultants		i			BORING			BC	RING NO. B-2
PRO	TOBLE	Pric	cerr'	s Pond	Si	mpline.	01d B	ridne.	New Jet	SCY			. NO. 1 OF 1
Cri	ENT M	adiso	on/CP	S Indus	Sti	cies							J. NO.81-07188-06
			CTOR	arten	Ce	orge	· · · · ·	1 212	1 2442				VATION
	DATE		TIME	DEPTH		CASING	TYPE	CAS.	SAMP.	CORE	TUBE	DAT	E START03/08/84
	DATE		IIME	DEPTI	-	CASING	DIA.		<del> </del>		3"		E FINISH 03/08/84
				<del> </del>	$\dashv$		WT.	<del> </del>			1400		LER R. Danielson
				-	$\neg$		FALL				24"		OO REP. KJL
О <b>ЕР</b> ТН FT.	CASING	SAMPLE	.	LOWS ON TUBE IR 12"	SYMBOL				FICATI	ОИ			REMARKS
1				P P	AND MANAGERY STREET, ST. ST.	A. Bla B. Tan C. do					ι	-5	pH=5.8, pond water Tube: 0-3.5' Rec.=36"
2		S <b>-</b> 1			7	<ul><li>D. Yell</li><li>E. do</li><li>F. do</li></ul>	low bro	own med	ium to	fine Sa	ınd		
4					17(6				END	OF BOR	ING @ 3	.5'	•
6										·			<b>0</b>
7   8   8												- 1	On calibration, pH meter measured 7.8 instead of 6.9.
9 -													•
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				ultants, l				BORING			BORING NO. 8-4
PRO	DJECT 1	ricke	<u>ee'</u>	Pond S	ampline.	Old B	ridge,	New Jet	sey		SHT. NO. 1 OF1
		371 CAN	/CPS	Indust Warren (	<b></b>						PROJ. NO.81-07188-06
GRO	OUND W	ATER		Marren (	eorge	1	CAS.	SAMP.			ELEVATION
	DATE		ME	DEPTH	CASING	TYPE	CAS.	SAMP.	CORE	TUBE	DATUM
		$\neg$			-	DIA.				3"	DATE START 03/12/84
						WT.				140#	DATE FINISH 03/12/84
						FALL				24"	ORILLER R. Danielson CWOO REP. KJL
PEPTH FT.	CASING	SAMPLE NO.	1	LOWS ON UBE R 12"	<u> </u>			FICATION Water	NC		REMARKS
		•		P 2						0.	5±1
1					A. B1	ack Org	anic S	ILT & F:	lbers.	Weeds-6	"± Tube: 0-3.0'
			<u> </u>	3.0				e Coarse			Rec.=NR, moved 2 Tube: 0-5:0'
2				TO TO THE PARTY.	C. do						Rec.=42"
-		S-1	1		D. Tan	Sand,	medium	tó fir	ıe		
3		}			E. do				•		
-			2		F. do						
4		ļ		7							
}		ļ	22	Z debutch	G. w/o and	ccasion	nal bla laminat	ck orga ions	nic mat	ter	
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L	rse Consu					BORING	•		BORING NO. B-5
PROJECT PT CLIENT Mad SORING CONT	TRACTOR W	i Industr	·íae	Old B	ridge.	New Jers	CY		SHT. NO. 1 OF 1 PROJ. NO.81-07188-06 ELEVATION
GROUND WAT					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE				SHELBY	DATE START03/12/84
ļ ————————————————————————————————————	+			DIA.				3"	DATE FINISH 03/12/84
				FALL				140#	DRILLER R. Danielson CWDD REP. KJL
CASING BLOWS	NO.	LOWS ON ON UBE R 12"				FICATION VALUE	ON		REMARKS
1 S 3 S 4 S 6 S 7 S 8 S 10 S		AND HARMAN	B. Grafin C. do D. do E. do	sy browne Grav	m Sand,	Occasi	onal p	Leces	pH=6.16, pond wath Tube: 0-4.0' Rec.=47"  On calibration, pH meter measured 7.8 instead of 6.9

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PR	TOBLO	ricket	r's	Pond S	ampline.	01d B	ridge.	New Jet	sey		BORING NO. 1
LLI	ELLI N.	dienn/	י פקי	Taduer	riae						PROJ. NO.81-071
60	OUND W	NTRACT	OR Wa	Tren (	George	γ	· · · · · ·	<del>-</del>	····		ELEVATION
Un.	DATE	TIM		DEPTH	CASING	TYPE	CAS.	SAMP.	CORE	TUBE	DATUM
		<del>                                     </del>		DEFIN	CASING	DIA.		<del> </del>		SHELBY	DATE START 03/
		<del>- </del>	-		-	WT.		<del> </del>		1 3"	DATE FINISH 03/
		_				FALL		<del> </del>		140# 24"±	CWOO REP. KJL
		w	BLO	ws _		L	<u> </u>			1 24 -	CHOUNEP. KUL
DEPTH FT.	CASING BLOWS	SAMPLE NO.	01	160		1	DENT	CIOATI	<b>~</b> * * * * * * * * * * * * * * * * * * *		
<u> </u>	E CA	X Z	TUE	3E   3	}	•		FICATI			REMA
	-		PER 1	-	<u> </u>		2.0	' Water			
	1 1	ļ		<b>6</b>	A., B.	. Brown	a Organ	ic SILT	& Sand	1_6"±	
	$\vdash$	- }	P							1-0 -	0.5
	[ ]	}			C. Br	own Sar	ndy Gra	vel-3"±			0.8
1		}	-	- E			- C i				
		<b> </b>	P		D. Gr	ay brow	vn Sand id laye	w/occa:	sional	orange	pH=6.78, po
		t		\$	E. do		id Taye	: <b>r</b>			Tube: 0-5.
		T I	<del></del>	;; ;;							Rec.=42"
2				3	F. do	W/infi	equent	lamina	tions,	'a" thic	k,
1		s-1	· P		G. 46	Silty	CIAY			•	
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Conv	erse Con	sultants, i	nc.	•	TEST E	BORING	LOG		BORING NO. B-9
PROJECT	Prickett'	s Pond S	ampling.	Old B	ridge.	New Jer	sey		SHT. NO. 1 OF I
CLIENT M	ndison/CP	S Indust	ries						PROJ. NO.81-07188-06
GROUND W		warren G	eorge	, ——				1	ELEVATION
DATE	TIME	DEPTH	CASING	TYPE	CAS.	SAMP.	CORE	TUBE	DATUM
UALE	11	Jerin	CASIIIG	DIA.				3"	DATE START 03/14/84 DATE FINISH 03/14/84
· · · · · · · · · · · · · · · · · · ·			1	WT.		<del>                                     </del>		140#	DRILLER R. Danielson
				FALL				24"	CWOD REP. KJL
CASING BLOWS	AMPLI NO.	BLOWS ON OB TUBE ER 12"		ļ		FICATI Water	ON		REMARKS
1		P	A. B1		ganic S	ILT-6"	thick		pH=6.88, pond wa Tube: 0-5.0' Rec.=39"
3	S-1	7 3 3 3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	D. Bro (½' E. do	own Gra	ay Sand	nd , occas: lay, so	ional 1 re oran	aminati ge stai	ons
5		6 %	F. do		<del></del>	END	OF BOR	ING @ 5	.01
6									On calibration, pH meter measured 7.7 instead of 6
,├—┤ ├—┤	-  -								
8									
9								·	
c						·		·	
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İ	Conv	erse C	onsult	ants, I	nc.		TEST	BORING	G LOG		BORING NO. B-
PRO	JECT	Pricke	ct's F	ond S	ampling	Old B	ridge.	New Jer	rsey	<del> </del>	SHT. NO. 1 OF1
CLIE	ENT M.	adison ONTRACT	/CPS T	Induct	rine						PROJ. NO.81-07188
GRO	UND W	ATER	Un Wa	rren u	eorge	<del></del>	CAS.	SAMP.	CORE	TUBE	ELEVATION
	DATE	TI	ME (	DEPTH	CASING	TYPE		JAME.	CORE		DATUM DATE START03/14/8
						DIA.				]3"	DATE STARTO3/14/8
						WT.				140#	DRILLER R. Daniels
		T	BLO	ws I.		FALL	<u> </u>		1	24"	CWDD REP. KJL
DEPTH FT.	NO X	9.5	04	100	1		INENT		•		
	CASING	SAMPLE NO.	TU8	- I <u>-</u>				IFICATI			REMARK
	<u> </u>	<u> </u>	PERT			<del></del>	2.	0' Water	<u> </u>		
	1		P	Z-03-4	A. B	lack Ord	eeni n	SILT-6"			pH=6.55 pond
Ī						Tack C.	galize	2111-0	<del></del>	· .	Tube: 0-5.0'
1					B. B	rown Sar	ndy Gr	ave1-9"	<b>:</b>		Kec.=40
	ĺ		<b></b>			<del></del>				···	· .
t	$\neg \neg$		4								
7											
2	1				!						
F		S-1	4	<b>—</b>	C. G	ray Sand	l, occ	asional	ኔ"thick	lamina	tions
				<b>-</b>	S	ilty Cla	y (ora	ange bro	wn stai	ning on	
3				16.07	<b>.</b>	oen stae	52 OT (	clay lay	er)		
-	——	}	13	HOUSE OF STANSON	D. do						
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4		t		- P	F. do				•	-	
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5		}	<del> </del>		H. do	<u> </u>					<b></b> -
L		ľ						END	OF BOR	ING @ 5	
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CAS.   SAMP.   CORE   TUBE   CATUM	SCRING CONTRACTOR MATTER George GROUND WATER GROUND WATER GROUND WATER GROUND WATER GROUND WATER OATE TIME OEPTH CASING TYPE F.I. SHELDY DATE STARTO3/12/12/12  DOM: 4" 3" CATE STARTO3/12/12/12  WT. 1409 1409 0761LER R. Daniels FALL 24" 24" 24" CWOO REP. KJL  FALL 24" 24" CWOO REP. KJL  TUBE PER 12"  F. A. Black Organic SILT 6 SAND  D. Brown Sand, coarse to medium, with fine Gravel F. do and gravel (3" layer)  G. Gray Sand, medium to fine  F. do and gravel (3" layer)  G. Gray Sand, medium to fine  F. do and gravel (3" layer)  F. do and gravel (3" layer)  G. Gray Sand, medium to fine  F. do and gravel (3" layer)  F. do and gravel (3" layer)  G. Gray Sand, medium to fine  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)  F. do and gravel (3" layer)	GROUND WATER  DATE  TIME  DATE  TIME  DEPTH  CASING TYPE  DIA. 4"  DIA. 4"  DATE  TIME  DEPTH  CASING TYPE  F.J.  SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  DATE SHELBY  CWOOD REP. K  REC.=42  D. Brown Sand with Organic SILT  C. do  2.0±'  D. Brown Sand, coarse to medium, with fine Gravel  E. do  T. do and gravel (3" layer)  G. Gray Sand, medium to fine  The state of the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with the shell with th	-07188-0 03/14/84 03/14/84 03/14/84 Canielsor JL EMARKS
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OATE   TIME   OEPTH   CASING   TYPE   F.J.   SHELBY   OATE START(3)/14//   3"   OATE START(3)/14//   3"   OATE START(3)/14//   140//   140//   ORLIGER   DANIELS   OATE START(3)/14//   140//   ORLIGER   DANIELS   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE START(3)/14//   OATE	OATE   TIME   OEPTH   CASING   TYPE   F.J.   SHELBY   OATE STARTO3/14/5	DATE TIME DEPTH CASING TYPE F.J. SAMP. CORE TUBE DATUM  CASING TYPE F.J. SILEN DATE START  DIA. 4"  WT. 140#  FALL 24"  DEPTH CASING TYPE F.J. SILEN DATE START  WT. 140#  FALL 24"  DEPTH CASING TYPE F.J. SILEN DATE START  TO DIA. 4"  WT. 140#  FALL 24"  DEPTH CASING TYPE F.J. SILEN DATE START  TO DIA. 4"  WT. 140#  DEPTH CASING TYPE F.J. SILEN DATE START  TO DIA. 4"  DEPTH CASING TYPE F.J. SILEN SAMP. CORE TUBE DATUM  SHELBY DATE START  TO DIA. 4"  DEPTH CASING TYPE F.J. SILEN SAMP. CORE TUBE DATUM  SHELBY DATE START  TO DIA. 4"  DEPTH CASING TYPE F.J. SAMP. CORE TUBE DATUM  SHELBY DATE START  TO DIA. 4"  DEPTH CASING TYPE F.J. SAMP. CORE TUBE DATUM  SHELBY DATE START  TO DIA. 4"  DEPTH CASING TYPE F.J. SAMP. DATE START  TO DIA. 4"  DEPTH CASING TYPE F.J. SAMP. CORE TO DATE START  TO DIA. 4"  DEPTH CASING TYPE F.J. SAMP. CORE TO DATE START  TO DIA. 4"  DEPTH CASING TYPE F.J. SAMP. DATE START  TO DIA. 4"  DEPTH CASING TYPE F.J. SAMP. DATE START  TO DIA. 4"  DEPTH CASING TYPE F.J. SAMP. DATE START  TO DIA. 4"  DEPTH CASING TYPE F.J. SAMP. DATE START  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DATE FINISH  TO DA	13/14/84 Danielsor JL MARKS
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## 1400 1400 ORLER R Daniels  FALL 24" 24" 24" CWOORF KJL  FALL 24" PALL CWOORF KJL  REMARK  REMARK  1.2' Water  P	WT.   1409	BLOWS ON TUBE PER 12"  A. Black Organic SILT & SAND  P  B. Gray Sand with Organic SILT  C. do  D. Brown Sand, coarse to medium, with fine Gravel  E. do  F. do and gravel (3" layer)  G. Gray Sand, medium to fine  P  Composite R.  140# DAILER R.  24"  CWOD REP. K  CWOD REP. K  120"  PH=6.61  Tube: Rec.=42  P  B. Gray Sand with Organic SILT  C. do  2.0±'  G. Gray Sand, medium to fine	13/14/84 Danielsor JL MARKS
Services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of the services of th	BLOWS ON THE PER 12"    P	BLOWS ON TUBE PER 12"  A. Black Organic SILT & SAND  P B. Gray Sand with Organic SILT  C. do  D. Brown Sand, coarse to medium, with fine Gravel  E. do  12  G. Gray Sand, medium to fine  7  20  14  15  16  17  18  18  19  10  11  11  11  11  11  12  13  14  15  16  17  18  18  18  18  18  18  18  18  18	MARKS
IDENTIFICATION TUBE PER 12"  A. Black Organic SILT & SAND  P. B. Gray Sand with Organic SILT  C. do  D. Brown Sand, coarse to medium, with fine Gravel E. do  F. do and gravel (3" layer)  G. Gray Sand, medium to fine w/occasional laminations w/Black Organic Silt  C. do with occasional laminations ½"-1½"  Tube: 5.0'-8.6  Rec.=24"  Note: 2D-Gray Silty Clay  END OF BORING @ 8.0'  On calibration.	IDENTIFICATION  REMARK  1.2' Water  P  B. Gray Sand with Organic SILT  C. do  Cravel  E. do  12  F. do and gravel (3" layer)  G. Gray Sand, medium to fine  F. do and gravel (3" layer)  G. Gray Sand, medium to fine  A. Gray Sand, medium to fine w/occasional laminations law-layer  C. do  P  A. Gray Sand, medium to fine w/occasional laminations law-layer  C. do with occasional laminations law-layer  C. do with occasional laminations law-layer  END OF BORING @ 8.0'  On calibration, pH meter measure 7.6 instead of 6.0.	IDENTIFICATION  TUBE  PER 12"  A. Black Organic SILT & SAND  P  B. Gray Sand with Organic SILT  C. do  Cravel  E. do  12  F. do and gravel (3" layer)  G. Gray Sand, medium to fine  7  20  14  15  16  17  18  19  10  10  11  11  11  11  12  13  14  15  16  17  18  18  18  18  18  18  18  18  18	MARKS
Tube: 0-5.0' Rec.=42"  B. Gray Sand with Organic SILT  C. do  D. Brown Sand, coarse to medium, with fine Gravel  E. do  12  F. do and gravel (3" layer)  G. Gray Sand, medium to fine  7  A. Gray Sand, medium to fine  For a sand, medium to fine  C. do with occasional laminations ½"-1½"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Note: 20-Gray Sand, medium to fine w/occasional laminations ½"-1½"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"  Tube: 0-5.0' Rec.=42"	Tube: 0-5.0'  Rec.=42"  P B. Gray Sand with Organic SILT  C. do  2.0±'  6 D. Brown Sand, coarse to medium, with fine Gravel E. do  12 F. do and gravel (3" layer)  G. Gray Sand, medium to fine  7 G. Gray Sand, medium to fine  7 G. Gray Sand, medium to fine  7 G. Gray Sand, medium to fine  8 C. do with occasional laminations ½"-1½"  Tube: 0-5.0'  Rec.=42"  Tube: 0-5.0'  Rec.=22"  Tube: 5.0'-8.0  Rec.=24"  Note: 2D-Gray Silty Clay  END OF BORING @ 8.0'  On calibration, pH meter measure 7.6 instead of 6	P B. Gray Sand with Organic SILT  C. do  2.0±1  Brown Sand, coarse to medium, with fine Gravel  E. do  12  F. do and gravel (3" layer)  G. Gray Sand, medium to fine	0-5.0'
2 S-1	2 7 S-1 C. do 2.0±'  6 D. Brown Sand, coarse to medium, with fine Gravel E. do  12 F. do and gravel (3" layer)  G. Gray Sand, medium to fine w/occasional laminations w/Black Organic Silt  C. do with occasional laminations ½"-1½"  thick  D. do  END OF BORING @ 8.0'  On calibration, pH meter measure 7.6 instead of 6	2 C. do  2.0±'  6 D. Brown Sand, coarse to medium, with fine Gravel E. do  12 F. do and gravel (3" layer)  G. Gray Sand, medium to fine	
E. do  12  F. do and gravel (3" layer)  G. Gray Sand, medium to fine  7  A. Gray Sand, medium to fine w/occasional laminations w/Black Organic Silt  B. do  14  C. do with occasional laminations ½"-1½"  thick  D. do  END OF BORING @ 8.0'  On calibration.	E. do  12  F. do and gravel (3" layer)  G. Gray Sand, medium to fine  7  A. Gray Sand, medium to fine w/occasional laminations w/Black Organic Silt  B. do  14  C. do with occasional laminations ½"-1½" thick  D. do  END OF BORING @ 8.0'  On calibration, pH meter measure 7.6 instead of 6	E. do  12  F. do and gravel (3" layer)  G. Gray Sand, medium to fine	
G. Gray Sand, medium to fine  A. Gray Sand, medium to fine w/occasional laminations w/Black Organic Silt  B. do  14  C. do with occasional laminations ½"-1½" thick  D. do  END OF BORING @ 8.0'  On calibration.	G. Gray Sand, medium to fine  A. Gray Sand, medium to fine w/occasional laminations w/Black Organic Silt  B. do  14 C. do with occasional laminations ½"-1½" thick  D. do  END OF BORING @ 8.0'  On calibration, pH meter measure 7.6 instead of 6	G. Gray Sand, medium to fine	
A. Gray Sand, medium to fine w/occasional laminations w/Black Organic Silt  B. do  C. do with occasional laminations ½"-1½" thick  D. do  END OF BORING @ 8.0'  On calibration,	A. Gray Sand, medium to fine w/occasional laminations w/Black Organic Silt  B. do  14 C. do with occasional laminations '"-1'' thick  D. do  END OF BORING @ 8.0'  On calibration, pH meter measure 7.6 instead of 6	20	
B. do  C. do with occasional laminations ½"-1½" thick  D. do  END OF BORING @ 8.0'  On calibration.	laminations w/Black Organic Silt  B. do  14  C. do with occasional laminations ½"-1½" thick  D. do  END OF BORING @ 8.0'  On calibration, pH meter measure 7.6 instead of 6	P A. Gray Sand, medium to fine w/second	
D. do  END OF BORING @ 8.0'  On calibration,	D. do  Note: 2D-Gray Silty Clay  END OF BORING @ 8.0'  On calibration, pH meter measure 7.6 instead of 6	6 S-2 laminations w/Black Organic Silt Rec.=24"	.0'-8.0'
END OF BORING @ 8.0'  On calibration,	END OF BORING @ 8.0'  On calibration, pH meter measure 7.6 instead of 6	, ————————————————————————————————————	
On calibration,	On calibration, pH meter measure 7.6 instead of 6	Note: 2I Silty Cla	-Gray y
DH meta-	pH meter measure 7.6 instead of 6		Ation
7.6 instead of 6		pH meter 1 7.6 instead	neasured

				sultants,					BORING			ВС	DRING NO.B-13
PRO	JECT	Prick	ett'	s Pond S	ampli	ng.	01d B1	ridge.	New Jer	sey		SH	T. NO. 1 OF 1
BOR	ING CO	adiso Ontra	TOR	S Indust Warren (	Ties Centre						<del></del>		OJ. NO.81-07188-06 EVATION
GRO	UND Y	VATER						CAS.	SAMP.	CORE	TUBE		TUM
	DATE		IME	DEPTH	CASI	NG	TYPE				SHELBY		TE START03/14/84
				<del> </del>	+		DIA.				3"	DA	TE FINISH 03/14/84
	<del></del>				<del>                                     </del>		FALL				140# 24"	cw	LLER R. Danielson DD REP. KJL
DEPTH FT.	CASING	SAMPLE NO.	.	TUBE	.1		1	IDENTI	FICATI	ON			REMARKS
				P					ILT, FI	BERS-8'		0.7	
1	· · · ·			P/6"	В. С.	Bro do	own Sar	ndy Gra	vel	-			Sample D-Silty Clay
2		S-1		9	D.	Ora lam	inge bi	rown Sa	nd with Silty C	occasi lay	onal		
3				8	E. F.	do do		•					
4				18			y Sand	i, medi	um fine				
_			18	/6"	н.	do							
5								٠	END	OF BOR	ING @ 5	.0'	Cleaned tube wi methanol & wate
6													
7			E										On calibration, pH meter measure 7.7 instead of (
8													
9													•
1											•		
10								A-94					
11	$\dashv$						•	41 24					

	Conv	rerse	Cons	sultant	s, la	na		•	TEST E	ORING	LOG		во	PRING NO. B-14
PRC	JECT	Prick	ett'	s Pone	d S	amplin	g. 0	old Br	ridge,	New Jer	sev	·	SHIT	.NO. 1 OF 1
CLI	ENT M	adisc	n/CP	S Inde	ustr	ries								J. NO.81-07188-06
BOR	ING C	ARTHO	CTOR	Warre	n G	eorge							_	VATION
	א פאט(			· · · · · · · · · · · · · · · · · · ·					CAS.	SAMP.	CORE	TUBE	DAT	TUM
	DATE		TIME	DEP	ТН	CASIN	<del></del>	TYPE	F.J.				DAT	E START03/15/84
				<del> </del>				DIA.	4"		ļ	3"	DAT	E FINISH 03/15/84
	<del></del>							WT	140# 24"			140#	DRIL	LLER R. Danielson
-				BLOWS	1.			1255				24"	CWD	DO REP. KJL
DEPTH FT.	CASING	SAMPLE NO.		ON TUBE R 12"	SYMBOL			l	IDENTI		ON			REMARKS
			T PE	:H 12				<del>,</del> .	1.0'	Water	<del></del>			
			. —	P	の変の	 A. :	Blac	k Ore	enic S	IIT we	eds-9"±		l	pH=7.9, pond water
ŀ		1			-8		do	018	Saure o	LLI, WE	.eus-7 _	0	.8±	Tube: 0-5.0' Rec.=48"
	P						<u></u>				<del>-</del>		<del>.</del>	xec.=46
1		I			(S)	•								
ļ				P	, S	_	_				_			
1			$\vdash$			<b>C.</b> 1	Brow	n Gra	velly	Sand-3"	I			
2	P				Ę.									
-			-		- \$\frac{1}{2}	D. (	Gray	Sand	l					
H		S-1	-	3	E.									
	, l		-			Ε. α	do			•				
3 <b> </b> -					Ś	E. (	40		•				1	
			-	6		_	_							••
						F. (	Gray	Sand	occas	ional c	lay lam	inations	s,	
, L	24				K	1	pock	et br	own san	ıd			- 1	
4 [					Ŋ	G. d	do							
_				12	9. E	н. с	io						j	
	_		<b>_</b>											
5  -	50		-			I. d	io							
	l			14	ž.	, -	٠		<del>-</del>					
<b> </b>			-	.→	Š	A. G	ray	Sand	occasi	onal la	minatio	ns of		Tube: 5.0'-9.0'
	1				Ž,	3	stai.	y Lla nine	y x" th top & b	iick, bi	rown sar	id		Rec.=27"
5					¥.	-	· call	R	roh a t					
L				26		B. d	lo							
					×.							•		
,  -		S-2	<u></u>		#UNIONAL SERVICE CONTROL	C. d	io							
	ŀ		<u></u>	•	\$12.5	~								
-					7	ъ.								
			-		14.	D. d	lo							
卜					3	_	_							
				28		E. d	lo							•
					Α. \$									•
$\downarrow$					Ę	F. d	lo			_			1	
1	1				T					END	OF BORIS	IG @ 9.0	ᆒ.	O
L			<u> </u>										- 19	On calibration,
			<u> </u>											pH meter measured 7.8 instead of 6.
$\vdash$			<b></b>			•							-   '	o instead of 0.
	į						•							
<b> </b>	$\dashv$		<del>                                     </del>										j	,
	ł		<del>                                     </del>						A-95					ŧ
	$\dashv$		<del></del>											
1													Į	
	<del></del>		L					,					•	

	Conve	erse C	onsi	ultants	i, In	C		• 	TEST E	ORING	LOG	v	BC	DRING NO. B-15
							85	old Ba	ridge.	New Jet	sey			T. NO. 1 OF
				Indu					<del> </del>				+	oj. no.81-07188-06
			OR	Warre	n (	eorge	-		615		6055			EVATION
	W GNU		<u> </u>	050=	<u> </u>	64611	_	TVAC	CAS.	SAMP.	CORE	TUBE		TUM
	DATE	TIA	4E	DEPT	<del>"  </del>	CASING	<del>"  </del>	TYPE DIA.	F.J.	<del>                                     </del>	<del></del>	3"		TE START03/15/84 TE FINISH 03/15/84
					$\dashv$			WT.	140#	ļ				LLER R. Danielson
				<del>                                     </del>				FALL	24"			24"		DO REP. KJL
DEPTH FT.	CASING	SAMPLE NO.	7	LOWS ON TUBE R 12"	SYMBOL		` .		IDENTI	FICATI Water	ON		<u> </u>	REMARKS
1				Р	PUNESCH WITH		··		ganic S	ILT-9"				pH=7.3, pond wat Tube: 0-5.0' Rec.=30"
2				P	KANAN AND A	· <b>C.</b> 1	Brov	wn Gr	avelly		u			
3		S-1		4	Secultary and sort	D. 1		wn Sai	nd					Probably lost
4				9	SE VENTARIA PA									3.0'-5.0', there moved 2' west an started sampling @ 3.0'.
5			9	76"	T.A.	<del></del>		CONT	INUED -	SEE LO	G B-15A	<u></u>		
6														
<b>7</b>  -			_											On calibration,
8														PH meter measur 7.9 instead of
9														
13														
									A-96					

	Conve	rse Co	onsi	ultants, li	nc.	•	TEST E	ORING	LOG		ВС	RING NO. B-15
PRO	JECT D	rickat	<u> </u>	Pond S	empline.	01d B1	ridge.	New Jers	se <u>"</u>			"NO. 1 OF 1
CLIE	NT Ma	dison/	CPS	Indust	ries				,	•1	PRO	DJ. NO.81-07188-06
BOR	ING CO	NTRACT	OR	Warren	George	,	r = - =	Y		Y ==		VATION
	UND W						F.J.	SAMP.	CORE	TUBE	4	rum
(	DATE	TIM	E	DEPTH	CASING	TYPE DIA.	4"	<del> </del>		3."	DAT	E START 03/15/84
						WT.	140#	<del>                                     </del>		140#	DRI	LLERR. Danielson
					<del></del>	FALL	24"	<del>                                     </del>		24"	CWI	DO REP. KJL
PT.	CASING	SAMPLE NO.	1	ON OB TUBE XX				FICATI Water	ON			REMARKS
1		•			·							
						·	. •			2	.01	
3	· ·			10	A. Gr	ay bro	wn Sand					Moved 2' West-s
4				10	B. do Si	w/ oc lty Cl		<b>1 lami</b> n	ations	ኒ		Tube: 3.0'-7.0 Rec.=30"
5		S-2			-	)						
6				25	D. do							
7				25	E. do			ENL	OF BO	RING @ 7	7.0'	
8							,					
9					·							•
10												
11						. А	<b>-</b> 97					
	1 1		$\vdash$		1							

	Conv	erse C	Cons	ultants,	Inc			TEST E	BORING	LOG	1	ВО	RING NO8-16
PRC	NECT 1	Pricke	22	s Pond	Samp	ling.	Old B	ridge.	New Jer	sey			. NO. 1 OF 1
CLI	ENT M	adison	/CP	S Indus	trie	<u>s</u>						PRO	DJ. NO.81-07188-0
BOF	IING CC	NTRAC	TOR	Convers	e Co	nsult	ants.	Incorpo	rated			ELE	VATION
GRO	ש מאטכ	ATER						CAS.	SAMP.	CORE	TUBE	DAT	
	DATE	T	ME	DEPTH		ASING	TYPE			İ	SHELBY		E START03/16/84
				1.0	N	one	DIA.	<b> </b>	ļ		3"		E FINISH 03/16/84
				<del> </del>			. WT.				40#		LLER WTM
	T	,	·		-		FALL	i	l		18년	CWE	DO REP. KJL
FT.	CASING	SAMPLE NO.	.		SYMBOL			IDENT	FICATI	ON			REMARKS
1					B	. do	ay Sand	ndy Gra i mixed	vel with 0:	rganic	SILT &		
2		S-1			3	. Bla			ILT @ 2		(3" [±] tl		Tube: 0-3.0' Rec.=30"
3					A B	SII	ick gra .T)	ay Grav	elly Sar	nd (Tra	ce Organ	nic	•
4		S-2			<u> </u>					organ	ic SILT	;' <del>'</del> ±	Tube: 0-5' Rec.=48'*
5					D.	. do	(w/o (	rganic		OF BOR	ING @ 5.	.0'	(24"-from above
6													
-		,											
7 F	$\overline{}$		_										
8													
9													•
-													
						,	A	-98					
1	_	ļ					A	- 70		•			

				ultants						BORING				PRING NO. B-17
PRO	JECT P	ricket	t's	Pond	S	ampli	ng.	014 B	ridge.	New Jer	sey			T. NO. 1 OF 1
CLIE	NT Ma	dison	CPS	Indu	SĘJ	cies				<del> </del>			_	OJ. NO.81-07188-06
	UND W		UK C	Onver	50	Cons	ult	ants,	Incorp CAS.	SAMP.	CORE	TUBE		EVATION FUM
_	DATE	ATER	1F I	DEPTI	7	CASI	NG	TYPE		Jame.	JONE	L		TE START 03/16/84
	15	<del>-  - ' ''</del>		Jerii		<del></del>		DIA.	<del> </del>	1	<del> </del>	3"	DAT	TE FINISH 03/16/84
$\vdash$					_			WT.	<del> </del>	1	<del>                                     </del>	40#	DRI	LLER WTM
								FALL	1	1		18"±		DD REP. KJL
ř.	CASING	SAMPLE NO.	ı	LOWS ON UBE	SYMBOL		•		IDENT	IFICATI	ON			REMARKS
ı	0.0		PEF	R 12"	भागना क्षाया का को जान का का निवास का का का का का का का का का का का का का		Br	own Sa	ndy Gr	SILT & S		<del></del>	.5±	
.					Ť	c.	qo		ganic	PILI				Tube: 0-3.5'
2		<b>S-</b> 1			Sirea Inter	D.	do							Rec.=42" (densified to 30"
1					では見る	E.	do							Boring located neamiddle of stream bed.
3					H. Harry									bed.
										ENI	OF BOR	ING @ 3	.5'	
4														
5									•					
<b>\</b>														
<b>k</b>  -	$\dashv$													
it	$\neg$	}												
ל		}												
														•
8 -		ļ	-											
<u>_</u>		<u>.                                    </u>												
-	$\dashv$	}					٠		1			••		
þ	$\dashv$						•						İ	
<u>,</u>		[								A-99				
<u>,</u>		- 1			1					** **			- 1	

(	Conve	erse Co	วกรบ	iltants, li	nc.	•	rest	BORING	LOG	•	во	RING NO.B-17A
PROJ	ECT p	ricker	r 1 s	Pond S	ampling	. 01d B:	idge,	New Jer	sev			. NO. 1 OF ]
CLIE	NT Ma	dison/	CPS	Indust	ries							J. NO.81-07188-06
BOR!	NG CO	NTRACT	OR	Convers	e Consu	ltants.			·		<u> </u>	VATION
GRO	UND WA	ATER					CAS.	SAMP.	CORE	TUBE	DAT	
٥	ATE	TIM	Œ	DEPTH	CASING			_	<b> </b>	SHELBY		E START 03/16/84 E FINISH 03/16/84
					ļ	DIA.				40#		LER WTM
					ļ	WT.	<del> </del>			18"±		O REP. KJL
т	—			Lows	<del> </del>	1,755	1		1	110 -		
DEPTH FT.	CASING	SAMPLE NO.	τ	ON OBE			IDEN	TIFICATI	ON			REMARKS
1		S-1		CHANNE AND AND AND AND AND AND AND AND AND AND		Brown Sa STLT Black gr		ravel, w/	little		c 5†±	Tube: 0-3.0' Rec.=33"
2					C. 1 D. 6 E. 7	Brown Sa do Tan Grav Tan Sand	elly	Sand	·			Boring located ne edge of stream be
3								. ENI	OF BO	RING @ 3	3.0'	
4						(						
5												
								·				
6												
7												
8			E			•						
9												•
10												
			上									

	Conv	erse C	onsi	ultant	s, In	ic.	•	TEST E	BORING	LOG		ВО	PRING NO. B-18
							Old B	ridge.	New Jer	sev			. NO. 1 OF 1
CLIE	NT M	dison	/CPS	Indu	sti	<u>ies</u>		<u> </u>	<u> </u>	· <del></del> -	<u> </u>	_	OJ. NO.81-07188-06
	UND W	NTRACT	UN L	varre	<u>1 G</u>	corge	7	CAS.	SAMP.	CORE	TUBE	-	TUM
	DATE		ME	DEPT	н	CASIN	TYPE	F.J.					TE START 03/16/84
				1.0	)	Non	e DIA.	4"			3"	DAT	E FINISH 03/16/84
							WT.	140#			140#	DRI	LLER R. Danielson
			ليب	0.46	$\dashv$		··FALL	24"	<u> </u>	<u> </u>	24"	CW	DO REP. KJU
FT.	CASING	SAMPLE NO.	1	LOWS ON UBE R 12"	SYMBOL			IDENT	FICATI	ON			REMARKS
				P	m obsects	Α.	Brown Gr	ay SILT	Y Sand				Boring located on delta, done with
1	P				12 A FO UM		io						tripod rig on land
	4			6	STEEP ST		Brown Bl io	ack San	đ				
2	4	S-1		9	CONTRACT.		Brown Sa	nd. Gra	vel				Tube: 0-5.0'
3	19	. 3-1			100 A 10 A	F.,	-						Rec.=48"
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4	35				E CALLON	H. (	io						
	64			5	SAMPARE			<del> </del>					
٦			2	0	逐落逐	<b>A</b> . (	Gray Sand	i					
6		S-2	2	0	Substitute.	В. (	io						
7					14857H1-174	C.	io w/cla	y lamin	ations	ኒ" thic	k.k		Tube: 5.0-9.0' Rec.=32"
8					10 March 1985	D. (	lo of Si	lty Cla	y, brow	n stain	ing		,
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1					<b>]</b>				END	OF BOR	ING @ 9	.0'	
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	Conve	erse Co	ons	ultants,	Inc.		•	TEST E	ORING	LOG		во	RING NO. B-19
PRO	JECT D	ricket	+ ' e	Pond	Samplin	18.	Old B	ridge.	New Jers	sey			. NO. 1 OF 1
CLI	ENT Ma	dison/	CPS	Indus	<u>tries</u>								J. NO.81-07188-06
BOF	ING CO	NTRACT	OR (	Convers	e Cons	ultá	ints,	Incorpo	rated	CORE	TUBE	DAT	VATION
	N DANC						TYPE	CAS.	SAMP.	CORE			E START03/16/84
1_	DATE	TIN	1E	DEPTH	CASI	NG	TYPE DIA.	<b> </b>	<del></del>		3"	DAT	E FINISH 03/16/84
							WT.		<del> </del>		40#		LER WTM
							FALL				18'7		DO REP. KJL
DEPTH.	CASING	SAMPLE NO.	,		SYMBOL			IDENT	FICATI	ON			REMARKS
i				,	25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55 25.55		own Gr	avelly	Sand				Tube: 0-5.0' Rec.=46"±(densified to 36" prior to
2					B. C.	Gra				w/ lam	ination	s	pulling tube)
3		S-1			o.		ack Gr	ay Silt	y Clay				
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<b>.</b>		Conv	ers	e C	onsi	ultants	s, Ir	10.	•	TEST E	BORING	LOG	·	вс	ORING NO. B-20	
	PRC	JECT	Pri	cket	<b></b> .	Pond	S	ampling.	01d B1	idge.	New Jets	sev			r. NO. 1 OF 1	
_[	CLIE	ENT M	adi	son	CPS	Indu	sti	ies						PRO	OJ. NO.81-07188-06	
		DUND V			OH C	onver	se	Consult	ants, .	CAS.	SAMP.	CORE	TUBE		TUM	
4		DATE		TIM	1E	DEPT	Н	CASING	TYPE	0.00	-	-	SHELBY		TE START 03/16/84	
									DIA.				3"	DAT	E FINISH 03/16/84	
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7	_	T .	<del>[</del>		B	LOWS	Τ.		FACE	<u> </u>	<u> </u>	<u></u>	18"	CWI	DO REP. KJL	
	DEPTH FT.	CASING	SAMPI	NO.	7	ON UBE R 12"	SYMBOL			IDENT	FICATI	ON			REMARKS	
	1		S	-1			मिक्टन्क्रिय अभिवासिस्यम्।	A. Bro	own San	nd, w/	leaves	,		.7'		
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SOURCE: WEHRAN 1986

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VE WEHRAN BYGINERING TEST BORING LOG CONSULTING ENGINEERS BORING NO. LE-PROJECT : CAL CHEMICAL SHEET NO. = OF : CLIENT : CTE CLEMICAL JOB NO. 75 3456 SAMPLE WELL NO. TYPE BLOWS PER CLASSIFICATION CONSTRUCTION REMARKS · W 5-4 55 54 3.2 Size SS 36 KOUT ٦ : Ó <u>د ک</u> 20-31 34-40 Ш <u>عا. 3</u> dark grey & SAND and 5 SILT, trace - clay RENTON 6.243 - grading to SILT + f SAND, little - Clay. A-8 SS 3+68 dark grey clay+silt 5.2 INNI - grading to dark grey 4.6 CLAY, little Silt 2.8 - occassional wood <u>5.0124</u> S-26 SS tan m-c-f SANC, trace 30 -100L5 S-37 SS Silt 40 grey c-m-f sano, +race 10015 5-35-25 Silt END OF EORING A-114

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ATE	TIME	146	TER					CAS.	SAMP	CORE	TUBE	DATE STARTED
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							FALL		1-012		<u> </u>	INSPECTOR
	<u>-</u> -	$\overline{}$	Γ	SA	MPLE	PALL   30"						
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PROJECT : ح	<u>3 (14</u> 2 4 2	FULC	CAL.		SHEET A	10. 5 OF C	
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WELL CONSTRUCTION	EEE S	Q TYPE		CLASSIFICATION		REMARKS	
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10	R-0	క్క	52-76		503'		
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	-05			tan +grey mf SAND,	54.01 trace		
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ek Minouit C	5-20	25	39-22	grey tan m-f SAND,	little		
Ú			26-23	Sil++Clay			
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DE ARTHURT OF BUILDINGS OF ERWINGE DIVISION OF WATER RESOURCES BURLIG NO. <u>12-13</u> TREMEDATE THE MANAGEMENT ELEV. TION DATE STARTED CAMBE 16. 10: FROJECT CPS-Madison PURPOSE Foring DATE FINISHED Accust 18, 111 LOCATION _____ WATER LEVEL ___ DATE ___ TIME ___ TYPE OF DRILLER ERILLENG Hollow Auger Larason HELPER INSPECTOR OR L Fyan SAMPLE SLE -CASTRG BLCASY FOOT MO. HELL CLASSIFICATION ' REMARKS SPOON BLOW *0 * ELEV. -____ DESIGN 17 8 1 9 | 11 6" yellow f. sand t/ 13" sample + 6" streak of lignite. fill 7" yellow med. sand.  $\Diamond$ 5 | 17 | 22 | -31 Top - gray c. sand u/|13" sample gravel. balance - gray f. to mad. sand. 14 | 17 | 16 | 18 Top I" Tan clay c. 8" sample 3 0~ sand. balance - Tan f. sand w/ mica & bottom 14" is gray A-117 ____ SCREEN SET FROM______TO____ SHEET 1 OF 2

E.	ISION OF WATER RESOURCES	C1_U.1	BORING NO.	<u> 0 + 05</u>	
	OF GROUND WATER MANAGEM	ent	ELEVATION		
	•	•	DATE STARTED		
inofe <b>c</b> i	PURPOSE		DATE FINISHED		
LEGATION	WA3			TIME	
TYPE OF DRILLING	DRILLER		HELPER INSPECTOR OR GEOLOGIST		
581551.10		<del></del>	GEULUGI	·	
יבבע-	SAMPLE	· ·			
ATZON	95	WELL	CLASSIFICATION /		
III.	CASHG TOOM TOOM SECON BLOW 6. BENE'	DESIGN	"0" ELEV. =	RE. GARKS	
a	0 = 2 " F 6 " PENE.				
	11 20 17 17	<del></del>	3" gray C. to mod.	15½" sample	
'			clayey sand.	121 287.718	
1 -	<del>                                   </del>		I" white clay 6" gray med. sand		
			wnite clay w/iron-		
, ,			stone	•	
			balance - gray f. to med. sand.	' !	
'  -			aica. Salia.		
				·	
50-	7 9 11 15				
			gray silty clay	16½" sample	
				•	
'					
5 5-	5 9 13 17				
			4" gray silty clay balance - gray clay	16" sample	
			w/Tr. lignite		
-					
60-	4 9 12 - 15	<del></del>	•		
			gray clay w/Tr. lignite	12" s mple	
J -			Note sealed hole with		
5-			2 bags cement and 1		
			bag bentonite		
<u>]</u> . [					
¶ -  [					
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3-			•		
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-   -					
		A-118			
5:	TO		TIIKS .	2 07 2	

	JÍV UREAU	IS D:	H OF GROU	WA ND	DBMIL ML PROVE ATER RESOURCES MATER MANAGEM	ENT	ECRING NO. 2 + 07.00' ELEVATION DATE STARTED August 12. 10
FACU:	ECT _	<u> </u>	Kad ∷	<u>en</u>	PURPOSE	<u> 3orinz</u>	DATE FINISHED August 21, 123
<u> ۵</u> ۱	1 101.				WA	TER LEVIII	L DATE TIME
DRIL	OF LING _:	<u> </u>	o <i>a -</i> .u	3÷:	DRILLER Larason	·	HELPER INSPECTOR OR  Curran GEOLOGIST -  Ryan
	EI.EV-		į	.S.A.	:GTE		
III.ADG	ATION	CASTAG BLOWS/ FOOT	NO.	TYPE	SPOON BLOW	WELL DESIGN	*O* SUEV. 4
						<del></del>	
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5-							
-				}			
				-			
: 0-				-			
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-			ł				
	ł			-			
	[			-			
25-	}			-		· · · · · ·	•
	ŀ			//-	6 2 12 - 24		5" dk 3r. f. sand 24" sample w/streak Tan med sand
4	[			7-			& gravel
	-			-			balance = gray f. sand - Note auger set-
1	].						tled 3" to 10"
-	-			-			
_	Ţ.						
3 -	-			- -	3   5   5   4		
			/	2	3 3 4		small ball of white lost sample clay and gravel
-		<del> </del>		-			
				-			
				//	4 3 5 7		gray silty f. sand
	-		12	4-			w/tan sand and streaks of tan & gray clay
	[_			-			la can d gray cray
						A-119	

## DIVISION OF WATER RESOURCES BORING NO. $\frac{2 + 37.05'}{}$ THEMEDAMAN SETAM CHUCAS TO UKER ... ELEVATION .ACJECT _____ PURPOSE _____ DATE FINISHED ____ LC JATION _____ WATER LEVEL ___ DATE ___ TIME ___ TYPE OF DRILLER DRILLING _____ HELPER - INSPECTOR OR GEOLOGIST ___ ELEV-SAMPLE CASING HOILY FOOT NO. WELL SPOON BLOW CLASSIFICATION ' REMARKS "0" ELEV. -DESIGN 6" PENE. 5 O -10/ 14/ gray clay w/sand on | sealed with 2 bag. 19 outside of sample cement and a bog

A-120

SCREEN SET FROM______TO____

Sentonite

. SHTET 2 CT ____

PROJECT LOCATION	U OF GRO <u>CRS-Madi</u>	UND WATE		ZMT <u>Porina</u> TER LEVEL	ELE: DATE DATE	VATION E STARTID E FINISHEI	14 - 5 - 1224 22, 1,32 D 1248 23, 1332 TIME	
TYPE OF URILLING	Hollow At	1361	DRILLER Larason		HELPER Curran Ryan	INSPECT GEOLOGI	TOR OR ST	
ATION EL -		SAMPLE SPOON 6° PEN	•	WEAL Design		CATION '	REMARKS	
50 75.				A-121			No samples just log. massive clay at sealed w/2 bags cament and 1 bag benconite .	

<u> </u>	NISTON OF WATER OF GROUND WATER	RESOURCES REMANAGEMENT		BORING NO. ELEVATION DATE START	5 + 9517"
	CPS-Madison	PURPOSE	oring	DATE FINIS	
LOCATION		WATER	LEVEL	DATE	TIME
TYPE OF DEILLENG		DRILLER Larason		HELPER INSP	ECTOR OR OGIST Dalton
HOSELY DEPTH	CLSING BLOWS/ FOOT NO. SECON	BLOW	ELL	CLASSIFICATION '	REIUGNIS -
5	#1 10 18  #2 21 9  #3 1 5br 12	16 12 15 36 1	Top med clay middor. Sand liggray w/ 2 at b choc clay	pettled tin to gray lt w/Tr. of or simiddle - Top 2" lt w/gravel.  p 9" 3r. v.f. sil nd w/some gravel Or. v.f. sand tan v.f. sand tan v.f. sand tan v.f. sand tan v.f. sand tan v.f. sand tan v.f. sand tan v.f. sand w/eaks of lignite  Stay clay the refer to med. sand w/streak of lignite  10" or. tan f. to sand w/streak of y at bottom.  dle 5" - layers of y at bottom.  dle 5" - layers of it. to med. sand w/streak of y at bottom.  dle 5" - layers of y at bottom 6" of to med. sand w/streak of y at bottom.  dle 5" - layers of lignitication.  Stay of lignitication of layers of layer of lignitication.  Solate gray layers w/c. silt t. vf	ty 20%" sample 3" fill in auger 6" fill in auger 6" fill in auger f
5-	#7   15 24		Top clay	beds vary '" to ral inches.  St" mottled gray w/br - gray v.f.  sand bottom 94"  V f sand Tr te	f
SCRE	EN SET FROM	TO	See :	ext Page SHEET	cr3

.cc				WATER MANAGEM PURPOSE WA		DATE STARTED DATE FINISHED DATE	
PE OF				DRILLER	. •	HELPER INSPECT	
315V-			_SA:	1912			
Hand ATION	CASTUC NLOUS/ FCOF	NO.	TYPE	SPOON BLOW 6" PENE.	NT L DESIGN	CLASSIFICATION '	RENULRIIS
		#3		17   4     53   55		Top 16" gray clay w/ silt to vf sand layer bottom 12%" gray whit vf sand Tr. lignite	र्
5				12 25 19 21		gray white f. sand w/ t" or - yel. seam late from bottom below is white f. sand + Trola	•
1-1-1-1-1-1		#9		3 5 3 10		Top 4%" gray f to med sand w/clots of clay bottom - layered whit & yel. or. f. clayey sand w/layer of ignit 2" up from bottom	e
5—				9 11 19 25			lost sample
9-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1						washed f. to med whit sand *	e No sample tries since ± 3 ft sand in auger
<u> </u>						washed f to vo white sand	No sample triei - ft sand in auger take <u>+</u> 10 gpm
		]    }   		24 33 27 28		Top 2" gray white f to yo sand w/white clay clots middle - light gray f clayey sand w/clayto clayey sand in the clay clay to clayey sand in the clay clay to clayey sand in the clay to clayey sand in the clay to clayey sand in the clay to clayey sand in the clay to clayey sand in the clay to clayey sand in the clay to clayey sand in the clay to clayer sand in the clay to clayer sand in the clay to clayer sand in the clay to clayer sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the clay sand in the cl	. <del></del>
73		] 	7/2	11 21 22 34		cop is" or clayey for sand w/clot of yeld white clay Bostom Is nottled gray to blar iry clay w/several gloss of gray foclayed	.   54" fill 0" fill pd in duger as
	SCREEN	1	1//	M 70	A-123	See Mext Page SHII	

## and the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second o DIVISION OF WATER RESOURCES BORING NO. $\frac{3 + 9317''}{2}$ DUREAU OF GROUND MATER MANAGEMENT ELEVATION DATE STARTED PROJECT _____ PURPOSE _____ DATE FINISHED ____ LOCATION _____ WATER LEVEL ____ DATE ____ TIME ____ DRILLER HELPER INSPECTOR OR GEOLOGIST ____ | ELEV- | SAMPLE ATION CASTRG BLOWS/ FOOT NO. WELL CLASSIFICATION ' SPCON BLOW 6" PENE. REMARKS DESIGN *0 * ELEV. =_____ Mottled gray-white 13" sample clay w/Tr. bl gray. clay Note sealed bottom of hole w/bentonite cement slurry 22 bags . cement and bag bentonite A-124

SHEET_3___CT__3__

SCREEN SET FROM______TO____

DEVISION OF WATER F SUREAU OF GROUND WATER	lus tró wollow Resources R management	BORING NO. TLEVATION	<u> </u>
PROJECT <u>CPS-Madison</u>	PURPOSE <u>Boring</u>	DATE STARTED	
LOCATION  TYPE OF D  TRILLING Hollow Auger	RILLER Larason	HELPER INSPECT	
CASING e. BEICHTH FOOT POOLS 22 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING 2500N COSING	( 0,000,000	CLASSEFICATION /	REMARKS
5- 7 6		Top 10%" or. silty gravel w/layers of . dark olive br. silty sand & white silty vf sand I"or. silty sand w/claylayers 1%" tan to white vf tof sand	
2 15 15	15 24	gray to or, tan vf to f sand w/streak of lig- nite 6" from bottom	15" sample w/5½" fill
#3	37 35	Top-several gravel stones & ½" ironstone layer 5" gray vf to f sand 6½" tan & gray vf to f sand rest-or. vf to f silty sand	15" sample
3 0 -		Top-several gravel stones 3" tan med to c silty sand w/screak of lignite bottom-gray med sand w/chocolate, or. & gray silty sand at base	lig" sample
3.0~	14 18	Top-Tr tan f clayev sand w/f gravel 9" can f to med sand w/or streak & Tr lignite 2" or. f to med sand w/streak ironstone botto an vf sand	15" sample
<u>a</u> 11	12 12	op 3"-Tan r to med and Bottom 5" layered r. & gray f to med sand / 1"layer of lignite n middle, silty at ase	ő" sample
	A-125	ome chips of lignite L	ost sample
SCREEN SET FROM	TO	. SHIET	1

## STULLY OF ENVIRONMENTAL INCLUSION

SCREEN GRO FROM TO

-J.K.: 1.J. TIVISION OF WATER RESOURCES

SUBJECT OF GROUND WATER MANAGEMENT BLEVATION 8+05 DATE STARTED PROJECT ______ PURPOSE _____ DATE FINISHED _____ LOCATION _____ WATER LEVEL ____ DATE ____ TIME ____

TYPE OF DHILLING	DRI	LLER	HELPER INSPECT: GEOLOGIS	
21.77- 21.77-	SAMPLE CASING PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF BT PROOF B	OW DESIGN	CLASSIFICATION '	REMARKS
-	#9		Top 4" gray vf sand lignite Bottom 3". layered or, gray white & yellow to or, silty visand w/lignite at top	
5	# 10 5 9	10 10	Top 6" light gray med - c sand w/clots of hite clay Bottom 6" gray to tan to or vf sand w/clots of oran-	12" sample
1 1	/// 44 33		hish grav clav at top	Lost semple
5 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	#11	30 41	rop 3" gray vf to c sand Bottom 13" lay- ered gray, light gray, tan & or. vf to f sand	16" sample
	# 12 27 31		light gray of to f sand w/streaks of gray, yellow & v dark gray w/top coarse & bottom silty	
-	#12 32 48	58 60	layered light gray & yellow med to c clayey sand w/layers ½" to 3" thick	w/ 9" fill
7 6	# 14 // 23 \$1		Tanish gray clay & gravel mix	l" sample not split
5	13 77 30 46	43 26 A-126	Fop 5" tanish gray lay w/silt layers " tanish gray vf sand 12" or vf sand becom- ing silty near bottom	2." semple

RIMENT OF ENVIRONMENTAL PROTECTION BORING NO. 3 + 05DIVISION OF WATER RESOUPCES SUREAU OF GROUND WATER MAN. JEMENT ELEVATION DATE STARTED PROJECT _____ PURPOSE _____ DATE FINISHED _____ LOCATION WATER LEVEL DATE TIME TYPE OF DRILLER HELPER INSPECTOR OR GEOLOGIST DRILLING ____ SAUDLE ELEV-CASING HOUSE FOOT WELL CLASSIFICATION ' SPOON BLOW LEMARKS DESIGN *0 * ELEV. =____ 211 361 301 40 -19161 Tanish gray to whicish 24" sample gray mottled clay w/ bluish or blackish specks Seal w/2 bags cement and { bag bentonite A-127 בין בין אחרי קדם מבסכבים

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	FOF GRUIND WA	ia Tar manaban		Ylivaiju	_10+41
	÷			DATE STARTED	
7200 <b>207</b> _	CRS-Madison	PURPOSE	<u> Poring</u>	DATE FINISHE:	
LOCATION		WA:	TER LEVEL	DATE	TIME
TYPE OF DRILLING	Rollow Auger	DRILLER Larason		HELPER INSPECT Curtan GEOLOGI Rvon	103. 03
ELEV-	SLEPAR.				
E .		ON BLOW PENE.	WZLL DESIGN	CLASSIFICATION '0° ELEV. =	REMARKS
	#1 14	37 56 63		Top 2½" or. silty clay lower 12½" layered or. & gray vf sand & mica	19" sample but 3" of it was fill in auger
300	51	6 16 12	A-128	l' layer of or gravel lower 10" mottled tan & gray vf sand - lignite throughout	Lost sample
SCR	EEN SET FROM	<b>:</b> o		SHEET	1 cr 3

ZKU OF GROUND WASTR WALLERS 10+41 DATE STARTED DUECT _____ PURPOSE _____ ____ DATE FINISHED LOCATION _____ WATER LEVEL ____ DATE ____ TIME ___ TYPE CY DRILLING ____ DRILLER EN ROMOEFRIG HILPER GEOLOGIST SAMPLE =:=:-CASTRG ROLLY ROOT RO. X211 CLASSIFICATION ' REMARKS MOJE MODES *0* ELEV. =____ DESIGN 6° ?ENZ. light gray wi sand w/ | 12" sample knots of clay at the cop and clayey sand layers in the middle several lignita layers 101 101 141 26 silty to clayey sand // gravel at top heavy Lignite seam in middle 2 | 2 | 2 | 1 | 37 | Lost sample 11 10 22 1027 Top-Tan m to c sand 15" sample Kiddle-dr tan f to m . sand w/streak of lignite (15") gray f to m sand w/ streaks of ironstone & liznite (14") Lower-2" or: f to m clayey sand No sample takenflowing sand Top-5" gray to or. or. = 23" sample to c sand 2" or. to white clay w/f gravel 17" on, gray y or. & white vf to f sand w/ white clay streak at 10" & bottom, Note the lower 14" has a clayey matrix, 1 | A-129 -SHEET 2 OF SCREEN SET FROM -45<u>2</u>- 3 07

DIMISSON OF WATER RESOURCES
MEAU OF GROUND WATER MANAGEMENT 10 + 41.7 ELEVATION DATE STARTED ROJECT ______ PURPOSE ______ DATE FINISHED _____ LOCATION _____ WAYER DEVEL ____ DATE ____ TIME TYPE OF DRILLING _____ DRILLER HELPER INSPECTOR OR GEOLOGIST SAMPLE ELEV-CASING NO.128 WELL CLASSIFICATION / SPOON BLOW REMARKS DESIGN *0 * ELEV. = 6 * 25:2. 14 140 136 150 dense gray or clay lower 4" mottled gray 15" sample to white gravelly clay Note sealed hole w/heavy benconite slurry to surface A-130

A-GURKAU	OF GROUND HATE	 R Manageme		álevanich	13+49
~~ ~ ***	GPS-Madison			DATE STARTED	June 7, 1781.
LOCATION	0:320.337	- <del></del>			June 3, 1981
200322011		WAI	ER LEVEL	0377	7272
	Hollow Auger	DRILLER Larason		HELPER INSPECT Curren GEOLOGI Ryan	OR OR ST <u>Delton</u>
227-	SAMPLE				
	CASTRG BLOUS/ FUODY TYPE 130.025		WILL DESIGN	CLASSIFICATION *3* ELEV. •	REMURKS
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1					
2 9				Tan f sand w/streaks of y gray f sand w/½" gravel & stone at bottom	
			ł	gravel & stone in a gray f sand w/2" gray clay at top & the bortom has streaks of gray silt	13½" sample
30-		30 35	·	Top-gray f sand w/ stone Middle 3" gray clay Bottom gray f sand	'6" sample
5-	14 28	32 55	1	Top 61" gray of to f silty sand w/stone at top fiddle-gray of to f sand w/t" gray clay sand sand w/t" gray clay sand	
			A-131		
577	EEN SET FROM	_ =====================================		SHITT	1

	: OF	BAGUNG WATER WAMAGEM		SLEVATUCE	13+49
			·	CETRATE STARTED	
PROJECT _		PURPOSE		DATE FINISHE	2
LOCATION		MA WA	TER LEVEL	DATE	TIME
TYPE OF DRILLING		DRILLER -	<del></del>	HELPER INSPEC	TUR UR
ELEV-		SAMPLE	<del></del>		
ATION	CASTRG M.OWS/ FOOT		WELL DESIGN	CLASSIFICATION '	REMARKS
5 0		19 20 27 27		dk gray vf to m sand w/dirty br silt or clay-Some lignite layers Tr gravel (stone) Note one black frg of crushed stone	,
o o o o o o o o o o o o o o o o o o o		7 13 13 16		gray of to f clayey sand w/large mica flakes bottom 2" is br gray clayey sand to sandy clay	lói" sample
		25   30   62   -67		Top 3" tan & or or vf to f sand w/some m sand and some silt lower 14" gray silty clay	42" sample
5		60   64		Top 9" can m to c sand at 9" a ¼" bk & rust layer bottom 6" y or, f to c silty sand	+9" =: 11 in avea-
5-		29   46   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   47   40   40		Top 12" Tan and white- m to c sand bottom-6" oram to c sand Tr silt or clay	18" sample +9" fill in auger

_c:_

SHIET 2

gurānu or g	ROUND WATER MANAGEM			AIIII	13+49
PROJECT	20222			STARTED	
LOCATION	PURPOSE			FINISHE:	)
	WA.	TER LEVE:	·		TIME
TYPE OF	DRILLER	_	HELPER	INSPECT GEOLOGI	TOR OR
ELE:-	SAMPLE				
ation g h	2 A SPOON BLOW 6° PENE.	WELL DESIGN	CLASSIFI *0* ELE7.		REMARKS
-1-1-1					
9 0-	25   42   36   33		Top- 3" It gray of sand 2" It gray of sand 2" It gray of sand Lower 16" is firsilty to command w/beddim ted - thin lignite	clayey sand a lt gray layey sand distor-	24" sample +4" fill in auge:
5			•		Sealed hole from 60' to surface w/ heavy benconite slurry.  Note the gravel & stone mentioned is samples is foreign
5-		۸_132			
		A-133		1	•

DATE STARTED June 1, 1981

FROJEJT CPS-Madison PURPOSE Boring DATE FINISHED June 3, 1982 LOCATION _____ WATER LEVEL ____ DATE ____ TIME ___

7772 07 DRILLER

	Ling : ————————————————————————————————————	Hollon	Auger	DRILLER Larason		HELPER INSPECTO Curran GEOLOGIS Ryan	OR OR OBlight
DEPTH	ATION	CASTUG. BLOUS/ FOOF	. 3 5 Sz	POON BLOW	WELL	CLASSIFICATION '0° ELEV. =	REMARKS
				1 1 1		or. to tan f. sand	
1 1 1 1 1 1			-	10 13 10		white-gray f. sand w/some or. f. sand and gray clayey silt & lignice gravel at bottom.	
5 -						gray f. to m. sand and lignice.	
2 0 -			4	12 17   18		br. to gray f. sand upper ft. gray f. to m. sand lower ft.	
			16			gray f. to m. sand w/bottom 3" alternat- ing layers of sand & lignite	
			24		·	can v.f. sand top gray f. sand w/ lignice and tr gravel	
20.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1				20  27  41		tan v.f. sand w/streaks of gray sand ton- stone layer at 31'3" and lignite at bottom	
1-1-1-1			12	10 25 10	A-134	gray v.f. to f sand w/streaks of lignice & f. to m or. sand + cr gravel at bottom a 1" lignical lights	

DEVISION OF MAISE ADJUMNING ..... _16±05 BUREAU OF GROUND WATER MAMAGEMENT ELEVATION DATE STARTED PROJECT _____ PURIOSE _____ DATE FINISHED ____ LOCATION _____ WATER LEVEL ____ DATE ____ TIME ____ TYPE OF DRILLING DRILLER HELPER INSPECTOR OR GEOLOGIST _____ SAMPLE TLT7-ATION CASTERN BLOWS/ FOOT *22: CLASSIFICATION ' REMURKS SPOON BLOW *3* ELT/. .____ DESIGN 6 * PENE. 65:11 30 166 1 gray & tan v.f. sand | 12"sample lower 3" - gray f. to m. sand w/lignice rop + gray a. co c. sand w/streaks of tan clay & lignice Lower 3" gray f. to m. silty sand w/l"gray silty clay 2 | 0 | 25 | 76 Top-gray m. sand Lower-4"laminated gray silty clay 17 | 38 | 55 | 72 alternating layers of black clay w/white to gray vf sand to siltvarved? - 1 1:1 1:1- 20 sample - lower ô" grav cement 1 bag benconite A-135

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CT.

18+00 LURDAU OF GROUND MATER MAMAGEMENT DATE STARTED PROJECT ______ PURPOSE _____ DATE FINISHED MATER LEVEL 100211011 DATE TYPE OF ERILLING Hollow suger DRILLER HELPER INSPECTOR OR Larason Curran 372n ILE/-SAMPLE CASING HOOF WELL SPOON BLO CLASSIFICATION / REMARKS SPCON BLOW "0" ELEV. -___ DESIGN No samples taken Sealed w/2 bags of cement and & bag bencomise. -72.54 A-136

SKEET____

_c:___

COT THE MOST TED WITHOU

			ree Surviv	19+95
10.27.27	179- Madieon PURPOSE	3arina	DATE STARTED	May 25, 1982
	——————————————————————————————————————	ER LEVEL		
775 C7 7122133	DRILLER Follow Augus Larason		MELPER INSPECTO Survey GEOLOGIS Ryan	TIME CR CR CT
ELEV- ATION -	CASTEG CASTEG COSTEG COOP COOP COOP COOP COOP COOP COOP COO	WELL CESIGN	Classification /	REMAKS
10-	7 10 12 13		y.or br. f. sand and gravel w/a clayey lignize layer at top.	
	12 11 17 7-		or. f. sand w/some gravel  tan to or. tan f. to c. sand w/l to 2" layers of f. gravel.	
	32   37   50		tan f. to vc. sand tr. lignite	
30	5   5   17   17		tan to gray f. to volsand w/lower 4" dry clayey v.f. sand tr. of lignite.	
	5   7   10   10		tanish gray vf. sand w/ spots of lignite	. : ! : . ·
	5 0 10 10	A-137	tan to gray v.f. sand w/some clay & lignite	
sa	RIEN SET FROM TO		. SXEET	1 07 2

TOP ALAL AND	· ·	<u>.</u>	19+35
TOF DRILLER	HELPER	INSPECTOR OF GEOLOGIST _	
SLEV- ATION SHOWS STOOM SLOW DESIGN  - STOOM SLOW DESIGN	CLASSIF:	CATION '	renas XS
6° PENE.	15	Tan vf. sand - redish . / cr. lignite	9" sample
5- 7 1 17 1 19 19	w/some li	Tan vf. sand ignite and f. avel " - red vc sand " or. vf. siley	7
50-	Vari column tan, pin sand w/l	ored red, y, k, & or. vf. ayers of lignife te in lower 2" is convolute.	& limo-
5- 4 17 1 7 24	for 10"- for to m Bottom y., pin sandy c	-pink & y. or sand 4"-vari colored k, white & gray lay tr. lignite	
51 7 1 25 32	pink, g	vari colored gray, y. & or. sand. 9" chocholate ry clay	
5-			No sample takon at 65-67-clay
5-	Or. t	o gray f to c. w/some gray clay	lost sample and had to regrad. Sealed hole W/ 2 bags cement & hag benconite
SCREEN SET FROMTO		SHEE	:2or
SCREEN SET FROM TO	-138	. SHEET	07

DATE STARTED 22+05 PROUECT _______ PURPOSE _______ DATE FINISHED May 20, 1981 LOCATION _____ WATER LEVEL ____ DATE ____ TIME ____ HELPER INSPECTOR OR GREET DRILLER TYPE OF DRILLING Parary Larason SAMPLE 212/-CASTRG BLOWS/ FOOT RO. ----CLASSIFICATION ' Z REMARKS SPOON BLOW L 6° PENZ. DEPTH ^0^ SLT7. -____ DESIGN No samples taken gray vf. sand w/ gravel. ca from siten samples. Not saved or. br. f to c. sand w/gravel. or. br. vf. sand w/ gravel or. tan vf. sand tr. gravel + mica tan vf. sand tr. clay w/heavy lignice layer ac 21' Tan vr. sand w/white clay streaks at 25-26 ft lignite layer tan to gray vf. sand 30w/ heavy lignice layers w/ large mida flakes at 35 ft. A-139 -. sxzst<u>1</u>ct<u>2</u> SCREEN SET FROM TO

SHEET______CT___?

20828	2 23	edia seen min	··········	·• · · · · ·	22+05
				SATE STÁRTED	
PROJUCT _		PURPOSE		DATE FINISHED	
LOCATION		WA	TER LEVEL	DATE	TIME
TYPE OF DRILLING	<del> </del>	DRILLER	 	HELPER INSPECTO	2. 63
SLEV-		.SAMPLE			
DEPTH	CASTRG BLOWS/ FOOT	SPOON BLOW	WELL DESIGN	CLASSIFICATION /	REMAKS
5 0 5 5 5 7 0 7 5 7 7 5 5 7 7 5 5 7 7 5 5 7 7 5 5 7 7 5 5 7 7 5 7 7 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7				continued  Tan vf. sand w/thin ironstone layers at 42 to 43 ft. tr. to no lignite.  pray vf. sand w/ lignite ironstone, and c. sand  Stay silty clay  gray vf sand to c. silt	

_ SCREEN SET FROM__

_ 10_

SHEET

OF.

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BUREA	O OF GROUND NATER MANAGEME	III -	) ZIZWAIICN	22+05
PROJECT	202222		DATE STARTED	<del></del>
LOCATION	PURPOSE	ER LEVEL	DATE FINISHE	
			DATE	TIME
TYPE OF DRILLING	DRILLER	_	HELPER INSPEC	OR OR IST
EL	SAMPLE			
ATIO:	CASING TOUR 100 TYPE CASING POOR 17 PER 2.5 SEED.	WELL DESIGN	CLASSIFICACIL: /	REJULIUS
90 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			continued  tan f. to c. sand w/ lignize	sealed w/ 1% bag cement pumped to bottom of note in heavy bentonice slurry.
202.5	DREEN SET FROM	A-141		3 e <del>.</del> 3

SHEET 3 CT 3

 guaza:	TOF GROUND MATER MA	 MAGEMENT	EDEWATION	-24+05
PROJECT	GPS-Madison pr	RPOSE Bories	DATE STARTED	100 3. 17:2
				May 13, 1982
		WATER LEVE	i pate	77112
TYPE OF DRILLING	DRIL	LER <u>aser</u>	HELPER INSPECTO	A OR
E22:-	SAMPLE		Ryan	
ATION DE -	CASING TYPE TOOM STONE SAISE.	WELL	CLASSIFICATION '	REMARKS
5			Tan to or. by. f. same w/lignite stringers, some gravel in upper 3"	
10-	15 10 14	1 10	Tan to y. or. f. sand w/gray layers tr. lignite & gravel + mica	•
5-		5/ 15 	Or. br. f. sand & gravel w/lignice bed & stringers	,
25 -	10 7 a		Alternating tan to gray f. sand w/or. c. sand & gravel. Lower 3" or. red. f. sand.	
5			Top-tan to or. or.  f. sand w/gravel.  bottom charcoal gray clay	
30-	5   13   15		Tan to dk. tan f. sand w/gravel stone at pottom	
	11 9 11	15	y. & gray vf. sand	
\$		A-142	alternating-or. br., ten, gray, white & bk lig- nite vf. sand w/2" gray silty clay at the top.	
	יים אינים אינים לידים אינים אינים אינים אינים אינים אינים אינים אינים אינים אינים אינים אינים אינים אינים אינים	<del>*</del>	<u> </u>	

, , , , , , , , , , , , , , , , , , , ,	: <b>.</b> : .		.D WAREN MERKU C.		<b>415</b> % A 725%	24+05
				•	DATE STARTED	
PROJECT _	PURPOSE			Ξ	DATE FINIS:	:20
LOCATION			W	ATER LEVE	DNTE	2777
TYPE OF DRILLING	<del></del>		DRILLER -	· .	HELPER INSPE	CTOR CR
ATECH ATECH		_SALDIZ				
	CASTING INLOSES / FOOT	110.	SPOON BLOW	DESIGN	CLASSIFICATION /	AINDAMS
- j - j - j - j - j - j - j - j - j - j					Or. br. vi. to f. ;  // l" gray silty cla at bottom	san i
50-					gray to ar. gray, to f. to f. sand w/2" pink of sand & stre of clay at bottom	•
5					san vf. sand	
		200		·	alternating it. br. gray br. clay w/gray white clay & vf. san silty partings in cl	4
70			13   30   52   90	·-	alternating gray cla and gray wf. sand w/ 2" to 6" clay & lig- nite	y
73					gray br. lignitic ca	
<u>.</u>					•	Sealed w/lb bag of volclay to increas weight the drillingud.
]				A-143		

SUREAU OF GROUND MATER MANAGEMENT SLEVATION -24+13. DATE STARTED PROJECT <u>GRA-Medison</u> PURPOSE <u>Sering</u> DATE FINISHED <u>Outober 15. 1981</u> NOCATION _____ WATER LEVEL _____ DATE _____ TIME ____ TUPT OF DRILLER
DRILLING Hollow Auger-Rotary Larason HELPER INSPECTOR OR German GEOLOGIST Dalton Ryan ===:-SAMPLE ATION CASING BLOWS/ FOOT NO. WELL CLASSIFICATION ' SPOCH EL REMARKS SPCCN BLOW DESIGN *0 * ELE7. -____ sealed W/3bags 13 | 25 143 160 olive or. massive finely laminated clay A-144

..... __ COREEN SET FROM _

___ *>_

SUREAU OF GROUND WATER MANAGEMENT ELEVATION AND ASSESSED DATE STARTED PROJECT <u>GPS-Wedison</u> PURPOSE <u>Soring</u> DATE FINISHED June 39, 1962 LOCATION _____ WATER LEVEL ____ DATE ____ TIME __ DRILLER MELPER INSPECTOR OR

Correct GEOLOGIST Dairon DRILLING Hollow Auger - Larason SAMPLE ===:-CASTUG BLOMS/ FOOF BO. ATION WELL CLASSIFICATION ' SPOON BLOW REMARKS RDISEC "0" ELT7. m____ 6° PENZ. Boring no samples sealed note w/1: bags cement 1. A-145

CORETH COR FROM

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SUFERU OF GROUND WATER MANAGEMENT -- 28+55 ELEVATION DATE STARTED Fine 10, 1981 PROJECT ____ C7S-Madison ___ PURPOSE _Boring DATE FINISHED CONTROL ____ WATER LEVEL _ 100%770% ______ DATE TYPE OF DRILLER
DRILLING Hollow Auger Larason INSPECTOR OR __GEOLOGIST_Dalton HELPER Curran Ry an SAMPLE ELEV-ATION CASTRG BLOUS/ FGOT BO. WELL CLASSIFICATION / SPOON BLOW AEMMEKS DESIGN *0 * ELEV. u____ 6° PENZ. 19 | 10/ 15 / 15 5" mostled gray f. 13" sample clayey sand, 1" or. sand w/gravel 3" white & or. f. sand 1" can sand 3" white f. sand 7 | 19 | 34 | -42 | 2" coarse scone & gravel 13" sample (foreign)mixed w/tan clay. Tr. of lignite 5" gray f. sand. 1" tan clayey sand 5" gray f. sand 5 1 22 1 421 coarse stone at top 13" sample (foreign)layered 500 or. m. sand 2" gray T. to c. sand w/clay streak. 54"gray f. sand wat" gray clay in middle la" or. f. sand w/ streak 12" gray f. sanji A-146

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c<del>.</del> 3

SCREEN SAT FROM _ _ _ TO_____

EUREAU	: OF GROUND HATER NAMAGEMENT	•	<i>2</i> 8+55
		DIETATION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE LA CONTRACTION DE	
PROJECT	PURPOSE	DATE STARTED	
LOCATION	WATER LEV	DATE FINISHED	
		51 DATE	
DRILLING	DRILLER	HELPER INSPECTO	CR CR
ELEV-	SMPLE		
ATTON - - DELTH	SEIE OF THE SPOON BLOW DESIGN	CLASSIFICATION '0" ELEV	REMAKS
	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	1" or. f. sand w/gray silty clay at bottom	
1-1-1-1	5 11 15 20	stone at top(foreign) 2"gray clay w. or.f. sand & gravel.	17"sample
50-		35" can to or. vf to f sand w/streak lignite 11" gray f. sand	
	3 23 40 45	3%" tan f. sand w/ scomes (foreign) 13%" gray v.f. to f. sand	16" sample
5—	25   48   52   58	12 " or. m to c. sand 6" or. f. sand	13" sample
50-	22  39  50 -60	2"or. c. sand mixed w/pink to white clay 12" or. f. to m. sand tr. gravel	14" sample
2 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	19 35 3/ 50//	3" or. c. sand 5" or. f. sitly sand 1" dk. or. f. sand 6" or. m to c. silty sand 4" or. m. to c. clay- ey sand -2" white mottled clay	21" sample
1 1	39 53 59 60/4	2" or. c. sand 5" can f. sand 6" or. f. sand 3" tan f. sand -2" white clay w/or f. sand at bottom	13" sample
50 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	45   79   A-147	3" tan c. to m. sand 1" white clay 9" tan f. sand 7" tan f. sand	20" sample
			lost pample
\$0.7	EEN SET FROM TO	. SHIIT	2 c <del>.</del> 3

BUR ZAU DR	daudio til da hanaden S	<b>51-7</b>			28+55
PROJECT			DATE		
	•	TER LEVEL		FINISHED	
TYPE OF DRILLING	DRILLER	_	HELPER	INSPECT GEOLOGI	TIME OR OR ST
	SAMPLE				
DUEPON CASTRG BLOUS/	SECON SLOW 6' PENE.	WELL CISIGN	CLASSIFIC "O" ELEV.		REMARKS
S C			,	•	lost sample
9 5 -	10   33   12   52		7" tan c. s 5" red br. .sand w/tr r clayey sand	m. to c.	12" sample sealed w/2 3/4 bacement
			•		
5		A-148			

	TOUR SECURE FOR CONTRACT	A ALUTYALA TER MAMAGEM	12117	-1277722011	30 +05
FROJECT	CPS-Madison		a and	DATE STARTED	July 7, 1982
LOCATION		<del></del>	Soring TER LEVEL		D July 10, 1991
			ilak bayet	· DATE	TIME
TYPE OF TRILLING	Auger & Rotary		<u> </u>	HELPER INSPECT Curren GEOLOGI Ryan	TOR OR IST <u>Dalton</u>
ATEO	NSING COAST	ON BLOW	WELL DESIGN	CLASSIFICATION '	2513513
-1-1-1-1-1-1	55	14 18 22		Copej" gray f. sand	l8" sample"
10-		11 12 15		bottom or. br. f. to c. silty, gravelly sand	·
1-1-1-1-1-1-1				tayered gray & or. v. f. to f. sand w/sever al thin tan clay laye	`
3 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		11 15/15	1	Note-or. v.f. sand in end of tube  gray f. sand w/some dark blotches & tan clare	lost sample  7" sample
5			A-149	clay clots	

	; J2 45.				<u>.</u>			30+05
						DATE	STARTED	
JEJE _			PU:	RPOSE	·	DATE	FINISHED	
CATION				WA	TER LEVEL		DATÉ	7 W T
TYPE OF DRILLING			DRIL:	LER	· 	HELPER	INSPECTO GEOLOGIS	
E127-		SAM.	P12					
ATTO:	CASTIIG HLOWS/ FOOT	TYPE	SPOON BLOW 6° PENE.		WELL DESIGN	CLASSIF:		A EN ULANS
50-			10 25 24			iron stone ok. f. sand & mica	e clay w/	•
5		-					·	losc sampie
55-		-	12 30 40			cop 2" tan f Balance - la f. sand, whi tan f. sand layer	yered or. ce clay, & in 1"-2"	i 9" sample
70-		·///. - -	15   43   46			top 3" tan c Balance-tan streak of or	f. sand w/	.j' sample
70-				5.4	A-150	tan. f. sa	nd -	12" sample
	REEN SET	T20:	70	!	150			2
	*****		· · · · · · · · · · · · · · · · · · ·		<del></del>	•	SHIET	2 cr 3

•			13130		RIZR WZSOCRO	: 4			<i>30+0</i> 5
1		AIAU	or Gr	ָבאניט'ני.	WATER MANAG	EMENT	` <u>21</u> 2.		
•							DATE	STARTED	
1	.05	=CT _			PURPO.		DATE	: FINISHE:	
}	, 500%	TION:				WATER DEVE		_ DATE	71/2
•	CRIL	OF LING	<u> </u>		DRILLER		HELPER	THSPECT GEOLOGI	CCR CR
<b>.</b>		ELE:-		_SA.	MPLE				
	DEFTH	ATION -	CASTRG BLOWS/ FOOT	TYPE	5700N BLOW 6" 75NE.	WELL DESIGN	CLASSIFI *0* ELEV.		RZIDANS
]:	5-							•	
	90				9 3 2 27 28		Gray to 5k.	Tignice &	lost sample
	110-					A-151	layered gray gray micaces clay and cla	ous sicly	bontom of hole at 109 2% bags of Type II and 1 bag of volutary

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1.07 377REA	AT HT HE OF HATER JOSE CROUND HAT:	RESOVAČES ER MANAGEM	EXT	ELEVATION	-32±50
בספונסגי	CFS-Madison		Boring	DATE STAR DATE FINI	
100%710%		W.2.	TER LEVEL		SHED July 14, 1782
TYPE OF DRILLING	Auger	DRILLER Larason	_	HELPER INS	PECTOR OR LOGIST Dalton
ATION E. ATION	87.	N BLOW	WELL DESIGN	CLASSIFICATION	, REMURKS
25	38 - 31 3	2   21   30	A-152	Top 6" can f. to a sand w/gravel and pellets or clots of lignite lower 6"or. f. to silty sand  Sealed w/3 bags Ty II & has of bent	f 12" sample f med

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DATE STATUS DIVISION PURPOSE Dering DATE STATUS DATE TOURS DATE STATUS DATE TOURS DATE STATUS DATE TOURS DATE STATUS DATE TOUR DATE TOURS DATE TOURS DATE TOURS DATE TOURS DATE TOURS DATE TOURS DATE TOURS DATE TOURS DATE TOURS DATE TOURS DATE TOURS DATE DATE DATE DATE DATE DATE DATE DATE	.zĀu	i Gradina	MATER MANAGEN		Z137	3.200	36+10
MACEN   SAMPLE   DATE   TIME		776 W21			DATE	STARIED	70ly 15, 1881
DRILLING Rollow Augest Lerason Gurian GROUNDS TR.    STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   STATE   S		U75-Mac130:			DATE	FIMISMED	
Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   Sample   S	200.77223		WA	TER LEVEL		DATE	TIME
1		Hollow Auge		<del></del>	Curran	INSPECT: GEOLOGIS	OR OR ST
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30   21 24 31 21   Top 2" or. f. sand tr 11" sample ironstone Balance-gray f. sand sample 35 or. f. sand 35 or. f. sand 14" sample 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f. sand 35 or. f.		CASTEG INLOUS/ FOOT NO.	1				RECUERCE
	3				ironstone Balance-gray	. sand tr	
	-			A-153			

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33737	PURPOSE		DATE STARTE	
LOCATION		TER LEVE:	DATE FINISH	EO
CYPE OF				TIME
INILLING	DRILLER	<del></del>	HELPER INSPEC	STOR OR SIST
2001 ATION	SAMPLE			
DEFTH	CASITE CASITE TOUT TOUT TOUT TOUT TOUT TOUT TOUT TO	WZLL DESIGN	CLASSIFICATION /	REMARKS
			property gray clays gray f. s. s. s. s. s. s. s. s. s. s. s. s. s.	
		A-154		

SHEET. 2

DIN 1811. VA KULLA KASUL KUSA Bureau of Ground Water Management - ELEVATION CETRATE STARTED Dat. 5, 1981 PROJECT __CPS-Madison PURPOSE Boring __DATE FINISHED _ Oct. 9, 1981 ------_____ WATER LEVEL _____ DRIE ____ TIME ___ TUPE OF DRILLER DRILLER Larason HELPER INSPECTOR OR CUrren GEOLOGIST Ryan SAMPLE ELEV-CASTRG BLOWS/ TOOT WELL CLASSIFICATION ' SPOON BLOW REMARKS DESIGN *0 * ELEV. =____ 6" PENE. 11 | 19 21 | 32 gray white sandy 24" sample clay speckled sealed w/3 bags cement i bag Senconite A-155 

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501					DATE	FINISHE:	) <u> </u>
		<del></del>		.TER LEVE:	·	_ 03.72	
TPE OF RILLING	<u> </u>		DRILLER Larason		HELPER	INSPECT GEOLOGI	TOR OR IST
ELE7.	-	SAULE	•		327		
ATIO	12:3	2 2 TYPE 20 22 22 22 22 22 22 22 22 22 22 22 22	N BLCW ENE.	WELL DESIGN	CLASSIT:	CATION (	RZWAXS
25 T		14	19126   25		recdish  a. sand  l" white c!  10" gray f.	can f. to Lay , sand	no odor.
50-				••			
΄ό <u>''</u> '							
		9 1 2	1   32   4:		tan c. sabalance-gray	and f	13" sample no odor sealed w/2; bag cement
- <u> </u> - -							
<b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>   <b>1</b>							
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JURBAU OF (	irdund water wilhagen		TUZWASICH	44+46
/ROJECT			DATE STARTED	
location	· · · · · · · · · · · · · · · · · · ·		DATE FINISHE	o
	······································	TER LEVEL	DATE	TIME
TYPE OF	DRILLER		HELPER INSPEC	TOR OR IST
2257-	SARLE			
DEPTH S S S S S S S S S S S S S S S S S S S		WELL DESIGN	CLASSITICATION '	REPORKS
-0_	2 1 13 14 13		moctled tan clay	
50	24 4563		gray white clay flaked w/tan clay	15" sample
			,	no odor scaled 개/2년 bags camons
5			-	
SCREEN SE	F 77.24	A-158	euron 2	

SHEET 2 ______ CF ___ 2___

DINDSIDM OF MAIDA RECOURTES

BUREAU OF CHOCHD KATER MANAGEMENT 47+03 BLEVATION DATE STARTED Sept. 17, 1981 PROJECT CPS-Madison PURPOSE Soring DATE FINISHED Sept. 13, 1981 LOCATION _____ WATER LEVEL ____ DATE ____ TIME ____ TYPE OF DRILLING _Mollow_Auger DRILLER HELPER INSPECTOR OR Larason Curuan GEOLOGIST kyan ELTV-SAMPLE CASTRG HOUSE/ FUOUF 17 ..... CLASSIFICATION / REMORKS SPOON BLOW CESIGN *9 * ELEV. * 6° 25%E. 15 | 3 | 11 | 12 | 4" gray clay w/screak 14" sample y.f. sand no edor Balance-y.f. to m. sand 5 17 110 140 cop-coarse gravel | 12" sample Bray f. sand w/screak no ocor pi y.f. sand 3 | 29| 37| 50 | lost sample

A-159

DIVISION OF VALUE ACCOUNTS

BUNEAU OF GROUND WATER WANT ARMENT 47.03 · · · · · · · · · · ELEVACION DATE STARTED CZHSIMIR BIAG . . DECORNIG . . DATE FINISHED LOCATION _____ WATER LEVEL ____ DATE ____ TIME ___ DRILLER TYPE OF DRILLING MELPER INSPECTOR OR GEOLOGIST ===:-374975 CASTING. INLOWS/ FOOT WELL CLASSIFICATION / SPCON BLOW REMARKS DESIGN ** ELEV. =____ 1" can clay mimad w/ à" sample c. sand no oder Balance-tan f. sand 123 | 29 | 45 1" gray silty clay
3" gray clay-speckled 23" sample no scor 3" lt. gray clay 4" y. f. to m. sand 4" it. gray clay streaked w/y.f.sand 10/ -2/20 1 30 3" dk, gray caly 2" gray m. sand 2" gray clay 4" gray clay w/cr.y 15" sample c. sand at top no cdo. balance-whitish gray A-160

DVI.TOUR OF GROUND WATER MANAGEMENT SEEMING ELEVATEDN DAJE STARTED <u>Beat, 18, 1981</u> PROJECT CPS-Madison PURPOSE Soring DATE FINISHED Sept. 24, 1982 WATER LEVEL _____ DATE ____ TIME ____ HELPER DRILLER INSPECTOR CR DRILLING Hollow Auger Larason Gurran GEOLOGIST Ryan ELTY-SAMPLE CASING NIOWS/ FOOT NO. WELL CLASSIFICATION / SPOON BLOW DESIGN '0' ELEV. e____ 5° PENE. 21 9 1 11 12 7%" br. f. sand tr. f. gravel l" or. f. sand 6" tan f. sand l" or. f. sand 5" tan  $\hat{t}$ . sand w/streak gray silt 7 1 -1 - 1--- 1 3" br. f. sand w/c. grave1 15" y. f. sand 2" tan clay 3" gray clay palance-gray f. sand 118 br. gray f. to m. sand w/2" br. gray 24" sample c. sand & streak of gray clay at bottom A-161

SHEET 1 07 2

49+05 WISION OF MATER ALSOYMUZE EAU OF GROUND WATER MANAGEMENT ELEVATION: DATE STARTED JUEST CPS-Madison PURJOSE DATE FINISHED WATER LEVEL _____ DATE ____ TIME ____ .CORTION ______ TYPE OF DRILLING _ DRILLER HELPER Curran INSPECTOR OR Latason GECLOGIST Ryan SAMPLE CASING PLOUS/ FOOT MO. WELL CLASSIFICATION ' REMARKS SPOON BLOW DESIGN *3 * ELET. -____ 6" PERE. 9 1 75 1 22122 palance-white f. to m. slight chemical sand w/streaks of gray 2" gray clay balance- 15" sample gray f. to m. sand w/ no odor streaks lignite á þ. 5 | 15 | 19 | - 25 14" gray silty clay 15" lignite 20" samble 4k" cray clay 741 29 | ó'gray clay balance-strangers 20" samples of clay layered w/gray اود اید اور اور f. sand some silvery gray flakes w/metallic luster. 17" sample top-gray silty clay balance-white clay scaled w/2 bags of cement 1 bag benconice A-162

smatt_ 2, ___ or, _2, _

J. E. FRITTS & ASSOCINC.  103 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105 No. 105			٠.	<b>ٻ</b>				)				
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# . FOR MONITORING **** PURPOSES ONLY

STATE OF NEW JERSEY
SENT OF ENVIRONMENTAL PROTECTION
SINISION OF WATER RESOURCES

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APPLICATION	6.1.56.1
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### WELL RECORD

OWNER CPS Chemical Company	ADDRESS P.O. Box 1	.62, Cld Bridge, N
Cwner's Well No. WCC-1d	SURFACE ELEVATION	
LOCATION		Spore mean pla level)
DATE COMPLETED 6 Jan 81	DRILLER J.E. Fritts, Co.	
DIAMETER: Top 6 inches Bottom	n 6 inches TOTAL DEPTH	101
CASING: Type Sch 40 PVC	Diameter Inches	Length 91 5
CASING: Type Sch 40 PVC SCREEN: Type Sch 40 PVC Size of Opening	0.020 2 Inches	10
Range in Depth    Top 91 Feet  Bottom 101 Feet	Geologic Formation	Raritan
Tail Piece: Diameter Inches		
WELL FLOWS NATURALLY Gallons per m	ninute at Feet above	surface
Water rises to Feet a	above surface	•
RECORD OF TEST: Date	Yield Gallon	s per minute
Static water level before pumping	Feet below surf.	
	•	
Pumping level feet below surf	face after hours	pumping
Pumping level feet below surf  Crawdown Feet Spec		•
	cific Capacity Gais, per min, per	· · ft_ of drawdown
Drawcown Feet Spec	eific Capacity Gais, per min, per	ft of drawdown
Drawdown Feet Spec	eific Capacity Gais, per min, per	ft of drawdown
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Drawcown Feet Spec How pumped Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT:	How measured  Mfrs. Name  H.P.	fL of drawdown
Drawcown Feet Spect  How pumped  Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type  Capacity G.P.M. How Drive  Depth of Pump in well Feet	Mfrs. Name  How measured  H.P.  Depth of Footpiece in well	ft of drawdown  R.P.M.  Feet
Depth of Air Line in well Feet Spec	Mfrs. Name  How measured  H.P.  Depth of Footpiece in well  ype of Meter on Pump	R.P.M Feet SizeInches
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STATE OF NEW JERSEY
DEPAR TENT OF ENVIRONMENTAL PROTECTION
JVISION OF WATER RESOURCES

PERMIT VO.
APPLICATION NO.
COUNTY Middlesex

### WELL RECORD

CWNER CPS Chemica	1 Company	ADDRESS	P.O. Box	152, 01d Er	idre y
Cwner's Well No. WCC- 2	24	SURFACE E	EVATION		
DATE COMPLETED 20	Jan 81	DRILLER J.E.	Fritts, Co	•	
DATE COMPLETED 20  DIAMETER: Top 6 in	ಣಿಣ Bottom ,	6 inches	. TOTAL DEP	—————————————————————————————————————	5
CASING: Type Sch	40 PVC	Diameter	2 Inches	l and	
CASING: Type Sch 40	PVC Size of Opening 0.	.020 Diameter	2 Inmes	Length	10
Range in Depth  Range in Depth  Botton  Tail Pisca: Diameter	46 Fee:	Geologic Forma	ition	Ra	ritan
Tail Piece: Diameter	Inches	Length	Feet		•
WELL FLOWS NATURALLY.			Feet abo	ve surface	
Water rises to	Feet abo	ve surface			
RECORD OF TEST: Date _		Yield_	Gall	ons per minute	
Static water level before pur					
Pumping level	feet below surface	after	ho	un pumping	
Drawcown	Feet Specific	Capacity	Gals, per min.	Der ft. of drawdown	
How sumped		How me	easured		
Observed effect on nearby we	elis	· ·			
PERMANENT PUMPING EQUI				•	
Туре	м	frs. Name			
Capacity	G.P.M. Haw Driven		H.P	RPV	
Depth of Pump in well	Feet	Depth of Footpiec	≥ in well	F	
Depth of Air Line in well	Feet Type	of Meter on Pump		SizeInche	ls
SED FORmonitoring	<u> </u>	AMOUNT	Average	——— Gallons Dai	iiy iiv
LUALITY OF WATER			General Van	<b>A.</b> 1	
Taste	Odor	Color		Temp. OF	•
OG <u>descriptive</u> (Give permits on bock of sheet o			Are samples availab	yes	•
OURCE OF DATA	Woodward-Clvde	e <i>log was mede, praese fu</i> e Consultant	imuh copy.j S	•	-
ATA CETAINED BY	Woodward-Clyde	e Consultant	S Date2	0 Jan 81	· · · · · · · · · · · · · · · · · · ·

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STATE OF NEW JERSEY
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MVISION OF WATER RESOURCES

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APPL	ICATION	NC.				_
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## WELL RECORD

APPLICATION NO.	_
COUNTY Middlesex	

				_
	. Owner CPS Chemical Company	######################################	P.C. Box	162, Cld Bridge, N
	Cwner's Weil No. WCC-3D	SURFACE F	PATION	
1.	LOCATION			MAGOVE Mean sea level)
ì.	DATE COMPLETED 6 Jan 81	Ruis J.E.	Fritts, Co.	
:.	DIAMETER: Top 6 inches Bottom	6		
<b>:</b> .	CASING: Type Sch 40 PVC	Diameter	2 Inches	Length 84
<b>:</b> .	CASING: Type Sch 40 PVC  SCREEN: Type Sch 40 PVC Size of Opening 0.0	20 - Diameter <u> </u>	2 Inches	Langua 10
	Range in Depth   Top 71 Feet  Bottom 81 Feet	Geologic Forma	ition	Raritan
	Tail Piece: DiameterInches	Length	F981	
•	WELL FLOWS NATURALLY Gailons per minute	e at	Feet abo	ve suriace
	Water rises to Feet above			
1.	RECORD OF TEST: Date	Yield_	——— Gallo	ons per minute
	Static water level before pumping	•	Feet below su	rface
	Pumping level feet below surface at	fier	hou	IS Dumpine
	Drawcown Feet Specific C	lapacity	Gais, per min in	er traf drawdawa
	How pumped	How me	easured	
,	Observed effect on nearby wells			
·.	PERMANENT PUMPING EQUIPMENT:			
	Type Mfrs	i. Name	·	
	Capacity G.P.M. How Driven _		и.р.	RPV
	Depth of Pump in well Feet	Depth of Footpiec	e in well	F
	Depth of Air Line in well Feet Type of			
	USED FORmonitoring		Average	Gallons Daily
		AMOUNT	Maximum	Gallons Daily Gallons Daily
	QUALITY OF WATER			
•	TasteOdor	Color		Temp. OF
	LOG descriptive   Give certails on back of sheet or on separate sheet. If success to		Are samples availab	
. :	SOURCE OF DATA Woodward-Clyde	<del>y mu mios, peas fu</del> Consultanti	mish cooy.)	•
. :	DATA CETAINED BY Woodward-Clyde	Consultant	<u>-</u> s ,	6 Jan 81
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CLASSIFICATION	Semole			No. of :	10" Siows	on \$000	0.	- 1 201 War
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APPLICATION NO. __ county Middlesex

	OWNER CPS Chemical Company ADDRESS P.O. Box 162, Cld Bridge, N
	Cwner's Well No. WCC- 4M SURFACE ELEVATION
	LOCATION
	DATE COMPLETED 14 Jan 81 DRILLER J.E. Fritts, Co.
	DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH
	CASING: Type Sch 40 PVC Diameter 2 Inches Length 47
	CASING:         Type         Sch 40 PVC         Diameter         2 Inches         Length         47         Fee           SCREEN:         Type         Size of Cpening         0.020         Diameter         2 Inches         Length         10
	Range in Depth   Top 47 Feet Geologic Formation Raritan
	Tail Piece: DiameterInches LengthFeet
•	WELL FLOWS NATURALLY Gailons per minute at Feet above surface
	Water rises to Feet above surface
<b>:</b> .	RECORD OF TEST: Date Yield Gallons per minute
	Static water level before pumping Feet below surface
	Pumping level feet below surface after hours pumping
	Drawcown Feet Specific Capacity Gals, per min, per ft. of drawdown
	How measured
	Observed effect on nearby wells
	PERMANENT PUMPING EQUIPMENT:
	Type Mfrs. Name
	Capacity G.P.M. How Driven H.P R.P.M
	Depth of Pump in well Feet Depth of Footpiece in well Feet
	Depth of Air Line in well Feet Type of Meter on Pump SizeInches
•	USED FOR MODITORING AMOUNT AMOUNT AMOUNT AMOUNT Gallons Daily
•	QUALITY OF WATER Semple: Yes No
	Taste Odor Color Temp OF.
•	LOG
	SOURCE OF DATA Woodward-Clyde Consultants
	DATA CETAINED BY Woodward-Clyde Consultants Date 14 Jan 81

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Boring No. 45-5

•	J. E. FRITTS &	ASSOC	. INC.						
	5-81					Jab	No. 2	2000	1634
Address	old Carlos N. J.							•	• . •
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round Surface	this boring is	·							
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# FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY JENT OF ENVIRONMENTAL PROTECTION (IVISION OF WATER RESOURCES

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APPL	.ICATION	٠٠ سے	. 112	5.9
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WELL RECORD

	. CWNER CPS Chemical Company	ADDRESS P.O. Box 162, Old Bridge, N
	Owner's Well No. WCC- 5M	SURFACE ELEVATION [ABOVE THEN BES AVEI]
	LOCATION	(Above mean sea aver)
· .	DATE SMPLETED 15 Jan 81 DRILL	ER J.E. Fritts, Co.
٠.	. DIAMETER: Top 6 inches Bottom	inches TOTAL DEPTH 36
Ξ,	E CASING: Type Sch 40 PVC	Diameter 2 Inches 1 25
	SCREEN: Type Sch 40 PVC Size of Opening 0.020	Diameter Inches = 10
	Range in Depth { Top25   Feet   G	eologic Formation Razitan
	Tail Piece: Diameter Inches Le	engthFeet
•	. WELL FLOWS NATURALLY Gallons per minute at _	Feet above surface
	Water rises to Feet above surf.	
•	. RECORD OF TEST: Date	Yield Gallons per minute
	Static water level before pumping	
	Pumping level feet below surface after	•
	Drawcown Feet Specific Capac	• •
	How pumped	
	Observed effect on nearby wells	
	PERMANENT PUMPING EQUIPMENT:	
	Type Mfrs. Na	<b></b>
		H.P R.P.M
	Depm of Pump in well Feet Dep	
	Description of Air Line in well Feet Type of Met	——· · ·
	USED FORmonitoring	AMOUNT Sallons Daily  Maximum Gallons Daily
	QUALITY OF WATER	
		Sample: Yes No
	Tare Odor	Color Temp or
	LOGCESCIPTIVE (Give press) on because of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the parties of the	Are samples available? Yes
	SOURCE OF DATA Woodward-Clyde Co.	nsultants .
	DATA DETAINED BY Woodward-Clyde Co.	nsultants 15° Jan 81

11/2/2-1-1

J. E. FRITTS & ASSOC. INC. Bridge, N.J. ed Datum used is _ bund Surface this boring is _ CLASSIFICATION Semple Depth Type 6-D 1st 6" | 2nd 6" | 3rd 6" 16'5" Brown Fine To CONES & 15-1 Sand with Petshes 5. Z 916 11 16 6.341 Israymed Sand 146 16 : 3 6 2 × × 15-5 71mc 5-6. 27% 311 7 9 10 A 10 4' 391 Gray FINE med SAND Traces of silry clay E7! GrayIsh white Eine sand 516 50K. 18 59/4 5- 50 5-7 164 184 7 10. 5-10 4984 511 16 24 371 5640 260 8 20 34 91 741 Light Brown Fine sand 2// 13 644.4661: 10 8 11 786 Brown TYPAY FINE SAND WITH LOYE'S OF SILTY CLAY 16 79.6 10.6 14 10/27 766 +0.6 Be. + Con =1

2/00/10/3	''	4.1	:0		- n.	useq		, casing.	A-	173
Mater lev	€'	·s—	<del></del>	Ħ.	Delow	Ground	surface a	t completion.		
	ę,	·S		ft.	below	Granna	surface	hrs.	after	completion

Bround Surface to ______ ft. used .

Foreman & Ly on a co

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## FOR MONITORING

STATEON VENTERSEY

1 STATEON VENTER PROTECTION

2 JUNISION OF WATER RESOURCES

PURPOSES ONLY

WELL RECORD

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CWMER_CPS Chemi	cal Company		·····*********************************	P.O. Box 16	2,7016 Barraga
Owner's Well NoWCC	<b>-</b> 60		SURFACE S	31 EN/A TION	उत्तर्भावस्य इत्
LOCATION			30111 ~02 3	101	वत्र त्याराष्ट्र रत
DATE COMPLETED 12	Jan 81	DR	11153 J.E.	Fritts, Co.	·
DIAMETER, Tan 6	•	_	6	•	
CASING: Type Sc	n 40 PVC		Diameter _	2 'nones	55
SCREEN: Type Sch	40 PVC Size of Op	ening 0.02	20 Diameter _	2 !nænes	50 Fig. 53 Fig. 139 Earger
Range in Depth	p 65 75 .	Feet	Geologic Form	ation	Ragitar
Tail Piece: Diameter	Inch	es	Length	5 	
WELL FLOWS NATURALL	Y Gailon	s per minute	at	——— Feet above su	inface
Water rises to	•				
RECORD OF TEST: Date	,		Yield.	Gailons :	er minute
Static water level before p	oumping			Feet below surfac	e
Pumping level	feet belo	w surface afi	ier	hours	umbing
Drawdown					
How pumped					
Observed effect on nearby					
PERMANENT PUMPING EC					-
Type	<del></del>	_ Mfrs.	Name		
Capacity					
Deppy of Pump in well					
Desth of Air Line in well					
USED FORmonitori				Average	
QUALITY OF WATER				Maximum	Gallons Dall?
Terre	Odor		Colon	Sample: Yes Tem	No
LOG <u>descripti</u> v	e		Color	An arms	0 0e, Ves
LOG <u>descriptiv</u> (Gira carbile on back of and	et or on apparets sheet	If electric log	was mude, present f	Are sambles available? Vinus copy.)	
Source of Data	Moodward	-Clyde (	Consultant	S	
DATA OBTAINED BY	Woodward	-Clyde (	Consultant	S Date	Jan 31

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J. E. FRITTS 8	ASSOC	INC	.)				
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Water leve is _____ft. below Ground surface at completic A=175

Water leve is ______ft, below Ground surface _____hrs, after completion.

STATE OF NEW JERSEY

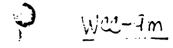
ABOUT OF ENVIRONMENTAL PROTECTION

JUVISION OF WATER RESOURCES

کے	1958 VITNO
	APPLICATION NO.
	Widdlage.

FURPOSES ONLY

	•		•
CWASE CPS Chemical Company	ADDRE	ss P.C. Box 1	.62, Cld Bridge, N
Owner's Well No. WCC- 7M	SURFAC	CE EL EVATION	
DIAMETER: Top 6 inches	DRILLER J.	E. Fritts, Co.	
DIAMETER: Top 6 inches	Bottom 6 inches	. TOTAL DEPTH	53
CASING: Type Sch 40 PVC	Diamer	2 laches	Feet
CASING: Type Sch 40 PVC SCREEN: Type Sch 40 PVC Size of C	pening 0.020	2	10
Range in Depth { Top 45   Bottom 55	_ Feet Geologic F	ormation	Raritan
Tail Piece: DiameterInc	ines (enorth	• •	
WELL FLOWS NATURALLY Galle			
Water rises to			surface
RECORD OF TEST: Date			
Static water level before pumping			
Pumping level feet be			
Drawcown Feet	Specific Capacity	Gais, per min, per	ft of drawdown
How pumped			
Observed effect on nearby wells			
PERMANENT PUMPING EQUIPMENT:			•
Туре	Mfrs. Name		
Capacity G.P.M. H	low Driven	н.р	R.P.M.
Dest. of Pump in well Feet	Depth of Foo	Tpiece in well	East
Description of Air Line in well Feet	Type of Meter on Pu	mp	Size leader
USED FORmonitoring		NT { Average	
QUALITY OF WATER		Maximum	Gallons Daily
Tes: Odor Odor	•	Sample: Yes	No
Odor	Color_	Te	mp of.
OGCESCIPTIVE	The life specific bearing the same and the	Are samples available?	yes
course as a Woodwa -	d_C1;;da Case;14;		
DATA CETAINED BY WOODWAT	d-Clyde Consult:	ents Date 16	Jan 81



## J. E. FRITTS & ASSOC. INC.

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9 33 Pa. 1/2 217 SLD 7/ 2 33 7/6 10 27 86  9 33 Pa. 1/2 217 SLD 7/ 2 33 7/6 10 27 86  44 WIT 1/2 Bo. SLD 3 35 74C 16 89 46  44 WIT 1/2 Bo. SLD 4 The 4 40 41C 9 18 25  2 53 Pa. 1/2 WIT SLD 6 50 57.6 19 75 62  5 56 GRAY 1/2 WIT SLD 6 50 57.6 19 75 62  5 56 GRAY 1/2 WIT SLD 7 55 56 76 33 57  END Con. my 566  12 57 660 56 2 18 C. Include 5 CPSS  SLD FACE 55 40 TO 42  HAMY MIND SEAL 42 40 TO 22  HAMY MIND SEAL 42 40 TO 21  CONCRETE SEAL 2 40 TO CA  SURFACE (Lock \$660)  16 16 16 MIND  16 16 16 MIND  16 16 16 MIND  16 16 16 MIND  Ground Surface to 11. used	<u> </u>	25	, 				- /		<u> </u>	<u> </u>			<del>  </del>
9 73 Re. The 297 Sho T 2 39 716 10 27 36  9 73 Re. The 297 Sho T 2 39 716 10 27 36  1 49 WIT The Bo. Sho 3 35 746 16 39 46  1 42 Be. Bo. The Sho I The 4 40 416 9 18 25  2 53 Pe. The 417 Sho 6 50 516 10 75 62  2 53 Pe. The 417 Sho 6 50 516 10 75 62  3 566 Gray The 45 2 Per. Included SCRIFT  Sho Govern The 3 2 Per. Included SCRIFT  9 And Pack 55 40 To 2'  Heavy Mud 5546 42' we To 2'  4 1 m/ co-critt Stal 2' up To Car  Sur the (Lock the)  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649 Concrite  1 649	24	IT. DA.	- GAA	1 /n w	75		25	25.5	<u> </u>	10	17		<u>:</u>
9 73 Me. /a 297 Shot 7 2 39 7/6 10 27 36  SO-8 13 Let Layirs  44 WIT /a Bo. Shot 3 35 74 6 16 39 46  42 Se. Bo. /a shot 1 The 4 40 416 9 18 25  5 SIT Layir 5 Shot 6 50 516 10 75 62  5 50 GRAY / The witten 5 45 466 15 21 77  5 50 GRAY / The witten 5 45 7 55 56 76 35 57  END Govern 566  1 25 Tally 56 2 P.V. Include 5 CPSS  4 Heavy Mud 5546 42 42 42 75 2'  4 1 W Co-critic 556 2' 40 70 CR  5 41 W Co-critic 556 2' 40 70 CR  5 42 42 42 42 70 70 CR  4 1 W Co-critic 556 2' 40 70 CR  5 46 466 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4666 2 4		SAD						<del> </del>	3	1	<u> </u>		<del> </del>
SO-P Black LAPPS  44 WAT /- Bo. SLD 3 35 74 C 16 39 46  42 Be, Bo. The Sand of The 4 40 WILL 9 18 25  5.CT LAPPER 5 45 166 15 21 77  2 53 M. The wast Sand 6 50 51, C 10 35 62  3 56,6 GRAY / The wast Sand. 7 55 566 76 35 57  END BOX 56.6  1-5 Talled 56 2" PUR. Include SCRIFT  4 MAY MUD 554L 57 UP TO 42  HANY MUD 554L 32' WP TO 2'  LESTALLED 56 2" PUR. Include SCRIFT  4 1	73	Ba. 5/4	. 2297	suo -	/	2	30	316	1 10	22	36		<del> </del>
44 4 4 5	i	50-8	Black	LASP	5			<u> </u>		<u> </u>	!	<u>!</u>	<u> </u>
# #2 Be, Po, " SAD & TAM & 40 41-5 9 18 25  \$ 5.4 Che 18 SAD & 5 45 446 15 21 77  2 53 Pa, The wit sand & 50 516 10 35 62  \$ 56.6 GRAY The wit sand. 7 55 566 76 35 57  END BOX: 56.6  1-5 Talled 56 2' PUE. Include 5CPSS  \$ 20 PACE 55 40 TO 42  Henry Mud 55AL 42' 40 TO 2'  41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 Co-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40 TO GRE  \$ 41 CO-CRITE 55AL 2' 40						3	25	36	<u> 6</u>	1 39	45	· 	!
5.17 LLYTR 5 45 W66 15 21 77  2 53 PA, 1/2 WIT SUND 6 50' FIG. 10 75 62  3 56,6 GRAY 7 72 WST SUND. 7 55' 565 76 35 57  END SORTING 566  12 5 TALLED 56 2' PUC. INCLUDE SCRIFF  SUND PACK 55' UP TO 4 2'  HEMY MUD 55AL 42' WP TO 2'  WSTALLED 5155L CASING PROTECTOR  + 1 2/ CO-CRITE STAL 2' WP TO GRA  SUR FALE (LOCK \$660)  1 644 MUD  1 644 CO-CRITE  1 644 MUD  1 644 CO-CRITE  1 644 MUD  1 644 CO-CRITE  FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN FORMAN					~  -	4	40'	414	<u> </u>	18	25	:	<u> </u>
2 53 Pa	1 4 2 1					5	45	46	15	21	! 77	ŧ	
1   STALLED   Ship   The stand   The stand   The stand   The stand   The stand   School      1   STALLED   Ship   2' P. W.   Include   SCHIF     SAND PACK   ST   WP TO   42'     Heavy Mud STALLED   STEEL CASING   PROTECTIVE     WASTALLED   STEEL CASING   PROTECTIVE     SAR PACK (Lock told)     1   6   4   4   4     1   6   4   4   4     1   6   4   4   4     Ground Surface to   11   used   casing     Foreman   Foreman   Foreman   Foreman   Casing     Foreman   Casing   Foreman   Casing     Country   Casing   Foreman   Casing     Country   Casing   Foreman   Casing     Country   Casing   Foreman   Casing     Country   Casing   Foreman   Casing     Country   Casing   Casing   Foreman   Casing     Country   Casing   Casing   Casing   Casing   Casing     Country   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casing   Casi	<u> </u>					6	50	51.6	1	75	62	i !	
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Jack Sb 2' PUC. Include SCRIF  Send Pack SF' UP TO 4 E'  Hay Mud Stal 42' UP TO 2'  LISTALIST STAL 2' UP TO GAL  LISTALIST STAL 2' UP TO GAL  Surface to 16 Mud Casing.  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  Foreman Land  F	56,6	URAY			- Ta !						į		i
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to below Ground surface at completion.					ion.				Forema				,
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# STATE OF NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESCURCES

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FOR MONITORING PURPOSES ONLY

WELL RECORD

	_				 _
APPLICAT	ION	NO.	_		_
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1.	CWNERCPS Chemical Company	p Anneess	.0. Box 162, C	old Bridge, NJ				
	Owner's Well No. WCC- 9m	SUBSACE EL EVATION						
2.	LOCATION			(Above mean sea level)	E991			
3.	DATE COMPLETED 15 Apr 81 DRIL	LER J.E. F	ritts, Co.					
4.	DIAMETER: Top 10 inches Bottom 10	inches	TOTAL DEPTI	55.5 H	Feet			
5.	CASING: Type Sch 40 PVC 0.020"	Diameter	2 Inches	Length 45	Faar			
6.	SCREEN: Type Sch 40 PVC 0.020" Size of Opening 45	Diameter	2 Inches	Length 10	- Feet			
	Range in Depth   Top Feet   Bottom Feet	Geologic Forma	tion <u>Raritan</u>					
	Tail Piece: DiameterInches [	Length	Feet					
7.	WELL FLOWS NATURALLY Gallons per minute at		Feet abov	re surface				
	Water rises to Feet above sur	rface						
8.	RECORD OF TEST: Date	Yield _	Gallo	ns per minute				
	Static water level before pumping Feet below surface							
	Pumping level feet below surface after		hou	rs pumping				
	Drawdown Feet Specific Capa	icity	Gals, per min, p	er ft. of drawdown				
	How pumped	How me	easured					
	Observed effect on nearby wells		<u> </u>					
9.	PERMANENT PUMPING EQUIPMENT:	•		~				
	Type Mfrs. N	lame						
	Capacity G.P.M. How Driven		н.р	R.P.M				
	Depth of Pump in well Feet De	pth of Footpiec	e in well	Feet				
	Depth of Air Line in well Feet Type of M	leter on Pump		SizeInches				
).	USED FOR	AMOUNT	Average	Gallons Daily Gallons Daily				
١.	QUALITY OF WATER							
	TasteOdor	Color		Temp. OF				
2.	LOG descriptive (Give details on back of sheet or on separate sheet. If electric log w							
	SOURCE OF DATA Woodward-Clyde Consultant		um <b>ar copy.</b> ]					
	DATA OBTAINED BY Woodward-Clyde Consultant		Date	5 Apr 81				

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J. E. FRITTS & ASSOC. INC.

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Ground Surface to ______ ft. used _____ casing. Water level is _____tt. below Ground surface at completion. after completion. Water level is _____ft. below Ground surface_ Boring stopped by-

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# STATE OF NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES

23-1	2212	t:
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FOR MONITORING PURPOSES ONLY

WELL RECORD

PERMIT N	0
APPLICAT	ION NO
COUNTY	Middlesex

			•			
1	CPS Chemical Company  Cwner's Well No. WCC- 11d	ADDRESS	P.O.	Box 162, 01d	Bridge, NJ	
	Cwner's Well No. WCC- 11d	. ADDRESS	· ——			
	Cwner's Well No	. SURPACE	ELEVA	TION	ove mean sea level)	F•
3	. DATE COMPLETED 15 Apr 81 DRIL	isa J.F.	Fritt	5 [0		
- 4	. DIAMETER: Ton 10 inches					
5.	SCREEN: Type Sch 40 PVC Size of Opening 0.020"	— Maries	2	OTAL DEPTH	71.5	Fe
6.	SCREEN: Type Sch 40 PVC 0.020"	Diameter	2	Inches	Length	F•
	C Ton 55	Diameter		Inches	Length	Fee
	Range in Depth $ \begin{cases} Top \phantom{00000000000000000000000000000000000$	Gealogic For	mation _	Raritan		
	Tai: Piece: Diameter Inches L	1	5			
7	WELL ELOWS NATIONAL INChes	ength		Feet		
<b>′</b> .	WELL FLOWS NATURALLY Gallons per minute at			Feet above sur	rface	
	Water rises to Feet above sur					
8.	RECORD OF TEST: Date	Yield	d	Gallons po	er minute	
	Static water level before pumping			Feet below surface		
	Purpoing level feet below surface after			hours ou	anio e	
	Drawdown Feet Specific Capac	city	G	de cos sis s		
	How pumped	Ham	0	iis, per min, per tt.	of drawdown	
	Cbserved effect on nearby wells	now	messured			
9.	PERMANENT PUMPING EQUIPMENT:					
	Type Mfrs. Na					
	Canadia. Mfrs. Na	me				
	Capacity G.P.M. How Driven		. · H.I	·	R.P.M	
	Destri of Pump in well Feet Dep	th of Footpi	iece in we	11	Feet	
	Description of Air Line in well Feet Type of Me	ter on Pump		Si	zeInches	
).	USED FOR monitoring					
		AMOUNT	Max	erage	Gallens Daily	
	QUALITY OF WATER		Sample	V.	Gallons Dally	
	TasteOdor	Color	semple.	T 43 N	4o	
•	LOGdescriptive	July		Temp	o of.	
	LOG descriptive  (Give details on back of sheet or on separate sheet. If electric log was	made, please	Are sar furnish co	nples available? _ oy.)	Ae2	
•	SOURCE OF DATA <u>Woodward-Clyde Consultants</u>					
•	DATA CBTAINED BY Woodward-Clyde Consultants			Date 16	Apr 81	<del></del> -
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Ground Surface to ft.	used casing.
Steam Surface to	Ground surface at completion.
Water level isft. below	he after completion.
ft. below	Ground surfacehrs. after completion.
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Foreman Library Company

form-DWR-133

## STATE OF NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES

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PERMIT	NG.
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FOR MONITORING PURPOSES ONLY

WELL RECORD

APPLICAT	10N NO
COUNTY	Middlesex

			•			
1.	. OWNERCPS Chemical Company	ADDRESS			d Bridge, NJ	
	Owner's Well No. WCC- 12m	SURFACE	ELEVA:	TION		
2.	LOCATION			. 1014	Above mean sea levery	Fee
3.	DATE COMPLETED 22 Apr 81 DRIL	LER J.E.	Fritt	s, Co.		
4.	DIAMETER: Top 10 : 10					
5.	CASING: Type Sch 40 PVC	Diameter	2	Inches	Leagen 45	Fee1
6.	CASING: Type Sch 40 PVC  SCREEN: Type Size of Opening 0.020"	Diameter	2	Inches	Leagh 10	
	Range in Depth { Top 45 Feet Bottom 55 Feet	Geologic For	mation _	Raritan	` ·	F 661
	Tail Piece: Diameter Inches L	ength		Feet		
7.	WELL FLOWS NATURALLY Gallons per minute at			Feet above	surface	
	Water rises to Feet above sur					
8.	RECORD OF TEST: Date	Yield	d b	Gailons	per minute	
	Static water level before pumping					
	Pumping level feet below surface after			hours	pumping	
	Drawdown Feet Specific Capa	city	G.	als, per min, per	ft. of drawdown	
	How pumped	How	measured			
	Observed effect on nearby wells		·			
9.	PERMANENT PUMPING EQUIPMENT:				-	
	Type Mfrs. Na	me			,,,,,,,,,	
	Capacity G.P.M. How Driven					
	Depth of Pump in well Feet Dep	th of Footpi	iece in w	ell	Feet	
	Depth of Air Line in well Feet Type of Me	ter on Pump	·		SizeInches	
10.	USED FOR	AMOUNT	. \ \ Av	erage	Gallons Daily	
		AMOUNT.	Ma	ximum	Gallons Daily Gallons Daily	•
11.	QUALITY OF WATER		Sample	: Yes	No	
	Taste Odor	Color		Ter	mp of.	
2.	LOG descriptive (Give details on back of sheet or on separate sheet. If electric log wa	s mede, please	Are sa	, mples available? oov.)	yes	
3.	SOURCE OF DATA Woodward-Clyde Consultants			, <b>**</b>		
	DATA OBTAINED BY Woodward-Clyde Consultants			Date 22	2 Apr 81	
			<del></del> .			

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Water level is.

Boring stopped by-

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### STATE OF NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESCURCES

	23-12236
PERMIT NO.	

## FOR MONITORING PURPOSES ONLY

#### WELL RECORD

PERMITN	10.	
APPLICAT	10N NO	
CHATY	Middlesex	

1.	CWNERCPS Chemical Company	P.O.	Box 162, 01d	Briage, NJ	
	wcc- 13m				
2	Owner's Well No. WCC2 13	SUNFACE ELEV	ATTON (AE	ove mean sea (evel)	Fee:
3.	DATE COMPLETED 20 Apr 81	es J.E. Frit	ts, Co.		
4. 5. 6.	DIAMETER: Top	inches Diameter2	TOTAL DEPTHInches	55.5 Length 10	Fee: Fee:
•	Range in Depth   Top 44 Feet  S4 Settom Feet			Earlyth	
	Tail Piece: Diameter Inches	ength	Feet		
7.	WELL FLOWS NATURALLY Gallon's per minute at		Feet above su	urface	
	Water rises to Feet above sur	face		·	
8.	RECORD OF TEST: Date	Yield	Gallons :	per minute	
	Static water level before pumping	· <u> </u>	_ Feet below surfac	re ·	• .
	Pumping level feet below surface after		hours p	Dumping	
	Drawdown Feet Specific Capa	acity	Gals, per min, per f	t. of drawdown	
	How pumped	How measu	ired		<del></del>
	Observed effect on nearby wells	<u> </u>	<del></del>		
9.	PERMANENT PUMPING EQUIPMENT:			~	
	Type Mfrs. N	lame			
	Capacity G.P.M. How Driven	<del></del>	н.р	. R.P.M	· ·
	Depth of Pump in well Feet De	pth of Footpiece in	well	Feet	
	Depth of Air Line in well Feet Type of M	leter on Pump	<del></del>	SizeInches	
10.	USED FOR	AMOUNT {	Average	Gallons Daily	
10. 11.	USED FOR	AMOUNT {	Average  Maximum  ple: Yes	Gallons Daily Gallons Daily No	
11.	USED FOR Monitoring  QUALITY OF WATER Odor	AMOUNT {  Same Color	Average  Maximum  ple: Yes  Tel	Gallons Daily Gallons Daily No	
11.	USED FOR	AMOUNT {  Same Color	Average  Maximum  ple: Yes  Tel	Gallons Daily Gallons Daily No	
11.	USED FOR Monitoring  QUALITY OF WATER Odor	AMOUNT Sam Color Ar	Average Maximum riple: Yes Tell re samples available?	Gallons Daily Gallons Daily No	

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# STATE OF NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESCURCES

	28-12236	::
ALT NO		

## FOR MONITORING PHRPOSES ONLY

PERMIT N	23-12235 o	
APPLICAT	10N NO	
COUNTY_	Middlesex	

	1 CILL DOED DIJE! MEET BECOMD COOKIA
1.	CPS Chemical Company  OWNER  ADDRESS  Owner's Well No. WCC- 15m  SURFACE ELEVATION  (Above mean sea ever)  Fee
	Owner's Well No. WCC- 15m SURFACE ELEVATION
2.	LCCATIONFee
3.	DATE COMPLETED 21 Apr 81 Deller J.E. Fritts. Co
4.	DIAMETER:         Top         10 inches         Bottom         10 inches         TOTAL DEPTH         51.5         Fee           CASING:         Type         Sch 40 PVC         Diameter         2         Inches         Length         Total DEPTH         10         Fee           SCREEN:         Type         Size of Coasing         0.020"         2         Inches         Length         10         Fee
5.	CASING: Type Sch 40 PVC Piameter
6.	SCREEN: Type Size of Opening Diameter Inches Length Fee
	Range in Depth { Top 38 Feet   Geologic Formation   Raritan
	Tail Piece: Diameter Inches Length Feet
7.	WELL FLOWS NATURALLY Gallons per minute at Feet above surface
	Water rises to Feet above surface
8.	RECORD OF TEST: Date Yield Gallons per minute
	Static water level before pumping Feet below surface
	Pumping level feet below surface after hours pumping
	Drawdown Feet Specific Capacity Gals, per min, per ft. of drawdown
	How pumped How measured
	Observed effect on nearby wells
9.	PERMANENT PUMPING EQUIPMENT:
	Type Mfrs. Name
	Capacity G,P,M. How Driven H,P R,P,M
	Depth of Pump in well Feet Depth of Footpiece in well Feet
	Depth of Air Line in well Feet Type of Meter on Pump SizeInches
0.	USED FOR Gallons Daily  AMOUNT   Amount   Maximum Gallons Daily
11.	QUALITY OF WATER Gallons Daily  Sample: Yes No
	Taste Odor Color Temp OF.
2.	LOG descriptive Are samples available? Yes
	SOURCE OF DATA Woodward-Clyde Consultants
	DATA OBTAINED BY Woodward-Clyde Consultants Date 21 Apr 81

## APPENDIX E BORINGS COMPLETED FOR MADISON INDUSTRIES

240.807 30/5/97	<u> </u>		<u>د د خ</u>	There The	
L PI.	1	SLOWS CM SAMPLE SPOON PER 6"	SYMBOL		REMARK
24	\$ 5 \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	12 16 18 19	क्षा कर कर कर कर कर कर कर कर कर कर कर कर कर	Situ sand, gravelly; light gray, coarse to fine sand grains, about 15 to slightly plastic fines, about 25 to medium to fin gravel (3M)  Souly aread sand; light gray, precoming medium sand grains (5P)  Poorly oraded sand; light gray, medium to fine sand grains (5P)  Claver silt, sandy; motived black gray about 20 to medium to fine sand grains in seams, microcous (mi)	5' } 5.5 }  5'  5'
	S. 8	10 10 11 15		Situ sand: light gray, medium to fine sand grains, about: 25 To nonplastic fines (SM)  Portu and sand; light gray, medium to fine sand grains (SP)	5

==C.			itional -	Ţe	<u> </u>	SHT. NO. 3 OF 4
11.	CASING	SAMPLE SAMPLE POPE	BLOWS ON SAMPLE SPOON PER 67	SYMBOL	IDENTIFICATION	REMARKS
50		S-10	50 100/2"	18.5	Party anded sand; light brown, medito fine sand grains (SP)	2 TA
55		S-11	18 21 23 11	174.0	Sittle sand, gravelly; light brain, coarse fine sand grains, about 8 90 fines - in clayers sit layers (ML), about 15 00 fine	10
		5-12	29	HEARAY.	Gravel (SW-SM)  Site sand, gravelly; light brown, presint medium sand grains, about 6 90 non- plastic fines, about 590 fine Gravel	
5	:	5-13	33	N. S. S. S. S. S. S. S. S. S. S. S. S. S.	(SP-SM) do.	
8		5-14	21 1 100 16" (	Lucia Lucia	do.	\
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LIEST	Mac				303. NO. 81 - 0713
CASING BLOWS	SAMPLE 110.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARK
	5.65	100	<u> </u>	Silte said, quaveily: light brown., predominate medium sand quains, close G 9 - non-plastic fines, about 5 70	
c	9-16	35		fine Gravel (SP-SM).	·
		100 / 2"	<b></b>	•	
5	S-17	15 17 13	1	Siltu sand, gravelly; orange brown, presominate medium sand grains, about 5 % non-plastic fines, about	
			1,	870 fine arevel (SI-SM)	BORING ELECT 106620
		20 40 70 10 100 / 2"	G-V-Con	into clay; away, laminated with fine and knows, micaccous, insignate (CL)	HOLE Growed Surface AFT Confletion
	-  -			End of Boring @ 91.7'	
	· [-	-			
				A-191	

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DERING CONTRACTOR Warren Gerrer Ton	SUENT		-	•	1 7.	_	2						10	. NC + 65 :
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2-1   71ME   DEPTH   CASING   779E   MUD   S.S.   DATE START   3   DIA	SACUN	: w	TER	-		•	-			SAMP.	CORE	Tues		
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DENTIFICATION  REMARK  STOOM  SAMPLE SHOW Said; DIENTS brown, Coarse to Time  12  Sand growns, about 15 % time grows  (SW)  Situ said; brown, medium to time said  GI  Situ said; brown, medium to time said  (SW)  Situ said; brown, medium to time said  (SW)  Situ said; brown, medium to time said  (SM)  Situ said; brown, medium to time said  (SM)  Situ said; brown, medium to time said  (SM)  Situ said; brown, medium to time said  (SM)  Situ said; brown, medium to time said  (SM)  Situ said; brown, medium to time said  (SM)  Situ said; brown, medium to time said  (SM)  Situ said; brown, medium to time said  (SM)  Situ said; brown, medium to time said  (SM)			Ī		<u> </u>	İ		FALL		30"		1	C.W.C	D PEP C . T
Gravelly size; pringe brown, course to fine  Sand grains, about 15 10 fine gravel  (SW)  Site sand; brown, medium to fine sand  Gravelly size; brown, medium to fine sand  (SW)  Site sand; brown, medium to fine sand  (SM)  Site sand; brown, medium to fine sand  (SM)  Site sand; brown, medium to fine sand  (SM)  Site sand; brown, medium to fine sand  (SM)  Site sand; brown, medium to fine sand  (SM)  Site sand; brown, medium to fine sand  (SM)  Site sand; brown, medium to fine sand  (SM)  Site sand; brown, medium to fine sand  (SM)	rr. CASING	DLOWS	SAMPLE NO.	S	on Ample Poon	SYMBOL	•	•	ודאפסו	FICATION	N			REMARK
Gravelly Raid; prayer brown, coarecto fine  12 Sand grains, about 15 170 fine gravel  (SW)  Site sand; brown, medium to fine sand  grains, about 12 10 non-plastic fines  (SM)  S.3 20 25  Gravelly Raid; brown, medium to fine sand  Grains, about 12 10 non-plastic fines  (SM)  S.3 20 25  Gravelly Raid; brown, medium to fine sand  Grains, about 12 10 non-plastic fines  S.4 Gravelly Raid; light gray, medium to  Gravelly Raid; light gray, medium to  Gravelly Raid; light gray, medium to  Gravelly Raid; light gray, medium to  Gravelly Raid; light gray, medium to  Gravelly Raid; light gray, medium to  Gravelly Raid; light gray, medium to			••					. •	•			•		
Gravelly said; orange brown, coarrect to fine gravel  Sand grains, about 15 40 fine gravel  (SW)  Solit sand; brown, medium to fine sand  (SW)  Solit sand; brown, medium to fine sand  (SM)  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)	3	_							. •		. :	<b>. 4.</b>		• • •
Gravelly said; orange brown, coarrect to fine gravel  Sand grains, about 15 40 fine gravel  (SW)  Solit sand; brown, medium to fine sand  (SW)  Solit sand; brown, medium to fine sand  (SM)  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)  Solit sand; brown, medium to fine sand  (SM)	4	$\dashv$										•		
S.2 Sittle sand; brown, medium to fine sand  S.2 Sittle sand; brown, medium to fine sand  (SM)  S.3 So So So So So So So So So So So So So	5		<del>G-</del> 1	12			sand gr							
5.2 22 grains, about 12 do non-plastic fines  (SM)  5.3 20 25 10 25 25 10 25 25 10 25 25 10 25 25 10 25 25 25 25 25 25 25 25 25 25 25 25 25												-		
S.4 G. Sittu soud; light gray, medium to  S.4 G. Sittu soud; light gray, medium to  Time soud grains, about 9 of more-			S·2			9	•							
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25 25 25 25 26 25 26 27 28 29 20 20 20 20 20 20 20 20 20 20 20 20 20		$\frac{1}{2}$					do.						·	•
5.4 G. Fine sand; light gray, medium to		- - - -	કે•૩	20		1					·			· 
5.2 Time sand grams, await 9 00 hora-														
5.2 Time sand grams, await 9 00 hora-								\		••	•			
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CASING II.OWS	SAMPLE HO.	BLOWS SAMPLE SPOON PER 6"	IDENTIFICATION	REMARK
24		÷	= Sittle send; motified brown, medice	
26	Ġ	5 7	fine sand grains, about 12 % Y plastic fines (SH)	von -
29				
31	9.G	\$ 21 37 42	Situsand; light gray, coarse to a sand grains, about 8 970 hon-pl	ine csite
22	•		fines (SW-SM)	
25 36	9.7	0 - 10	Situsand; light army coarse to sand grains, about 12 90 non plastic fines (SM)	
38 29	•			
41	5.8	19 23	Silty sand : light gray , of to fine sand grains, about 8 of non-plastic fines (SW-SM)	
43				
45 46 47	5.9	33 70 100 / 2"	ල්.	
41 45			A-193	

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CU.ENT	Mad	ison In	و باغ	ries The.	22 /	OJ. NO. 81 - 07 31
CASING BLOWS	SAMPLE 110.	BLOWS ON SAMPLE SPOON PER ST	SYMBOL	DENTIFICATION	·	REMARK
50	8-10	57 (CO/5"	15 kg	well graded send; light brown, to fine send grains, about 5	, ೦ಜ೫೩ ೯೨	
				hon-plastic fines (SW)		
	5-11	50 100		da.		••
				•	•	·
, c	d in	25		borly oraced send; light brown, about 5	medium To	
,				on-plastic fines (SP)		
3	5-13	100 / 5"	1	edium sand grains, obout 5		
	 			on-plastic fines (SD)		•
	3.14	17 22 23 29	\$	ellometed sand; thour, coarse to	plastic!	
	-  -  -  -		<u>ا</u>	nes (SW) letered with: 11th clau; gray, micross, mon (L) A-194	. 1	

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ENT	- <del> </del>		ustries Inc.	
CASING ULOWS		BLOWS ON SAMPLE SPOON PER 6"	IDENTIFICATION	
	5.15	50 G3 100 / 3"	40.	
	<u> </u>			30.0'
.0	5-16	27 G3 :	Silt x clay; gray, lamined fine sand lenses, micace (CL)	te with
5		•		83.5
	5-17	100 / 5"	Sitty sand; light gray, profine sand grains, about a plastic fines (SM)	redominate 30 Mp slightly
	·		Clau & silt sandy; light on	Scene was fine was fine was fine been been been been been been been b
	5-18	39	Smewhat layered with about 40 arcins (CL) End of born	To fine sand Consumon
·				<b>B</b>
	.	·		
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THE INTERPRETATION OF SHILL BOOK AND DROUNDWATER CONDITIONS SEE TEXT OF CONVERSE CONSULTANTS AFFORT, OF MAKEN THIS LOC IS A PART,

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	I   BLOWS	<u> </u>	700	1 30 1			CWOD REP. C. TABLE
Prem FT. CASING BLOWS	SAMPLE SPOON PER 6"		IDENT	IFICATIO	) N		REMARK
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15	S-3 20 34 22	predomina	d; gray, te fine;	erra g	rains	, about	7
20	A 33 AR 50 55 55 55 55 55 55 55 55 55 55 55 55	_	ormanie, ab	out 35 dium sa dium sa dominate	urgina ng ara 1,2 non	n-plazium ins (SM sam d	1)

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	CASING	SALAPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	•	REMARK
50		S-10	23 23 25 30	Beite in Th	do.		
'·		S-11	37 45 47 46		Rody graded sand; gray, presommate nedum sand grains, about 3 90 non plastic fines (SP)	-	
<u> </u>		S-12	16 22 23 27		Poodu aread sand; light brown, predominate coarse to medium sand grains, about 390 non-plastic fine (SP)		
5 T		5-13	100		Rodu and eard; gray, predomina nedium sand grains; about 5 90 non-plastic fines (SA)	ite	
		3.14	45 100	A. a. a.	] Co. 73.		
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FF.	BLOWS SAMPLE HO.	BLOWS ON SAMPLE SPOON PER 6"	IDENTIFICATION	REMARK
76	9.15	100 / 5"	Sitty cizy; gray, insmanie, laminates with +	
			End of Baring @ 75.9"	BOREHOLE GROUP
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	CASING	SAMPLE 110.	SAMPLE SPOON PER 67	SYMBOL	IDENTIFICATION		REMARK
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25 -		6-5	26		Borly are ded sand; light gray, med	אר - אירואצי	
25			100   5"		to fine sand grains, about 4 hon-plastic fines (SW)		
23 -							•
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21		S. G	10 25 35	N. T. S.	do.		
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37					3.	9.5 1	•
39 _				<u> </u>			
46  -		S-B	19		Sittle sand; light gray, medium to s	fine	
42 -			24 23 30		sand orains, about 15 To non- plastic fines (SM)	•	
43							
14 <u> </u>  -  5 <u> </u>							
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IN P. III	CASING IROVS	SAMPLE 110.	BLOWS ON SAMPLE SPOON PER 67	SYLABOL.	JOENTIFICATION	REMARI
		S-:5	25 36 44	Marie Land	Situated; gray inorganic, laminated with this time sand lances (CL)	ices now 5 20
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						1	FALL		_3° "	1	!	10.4	CD REP.	المرودية المر
DI.T. 11.	CASIIIO DLOWS	SAMPLE HO.	SA SA	LOWS ON LMPLE POON ER 67	SYMBOL			IDENTI	FICATI	ON				REMARK:
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CASHIG HOWS	SAMPLE 5 HO.	BLOWS ON SAMPLE SPOON PER ST	DENTIFICATION	1230	REMARKS
25	4 4 G)	GO 100 / 4"	Sitt sand; orange brown, predoming medium sand avains, about 8 mon-plastic. Times (SP-SM)	-le	
45	\$-5	24 38 35 5!	Portuguaded sand; light aray,  predominate medium sand grain  elect 3 to rerelate fines (Si  A-204	z,	

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CASING IN OWS	SAMPLE SPOON PER 6"	SYABOL	IDENTIFICATION	REMAR
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	A 24 S-9 23 E 53	Clau + silt;	orange brown, cares to till about 18 do slightly plate of carrier, laminate eners of fine sand (CL)	ic.0
e	\$10 \frac{18}{51}	E co	of Bering @ 72.0'	BOREHOLD GROU
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TIME   SEPTH   CASING   TYPE   WUD   S.S.	80F NG C	ONTRAC'	TOR	10/2-	<u></u> Ge:	-32			<u></u>			<del></del>
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10.110	CASING	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 5"	SYMMOL	IDENTIFICATION	REMARKS
50		S-10	G0 100 / 4"		Pool anded sand; light bown, comes to medium sand areins, about 390	
. 55		G-11	100		hon-plastic fines (SP)  Poorto anada sand; gray, coarse to reduce sand arains, about 390 non-plastic fines (SP) layered with:  Silt + clay; gray, inorganic (ML)	
Ge		S-12	100	(S)	Poorly aread saud; light brown, predominate medium saud orains, about 37. non-plastic fines (SP)	
<b>65</b>	·	G-13	1! 100 / 3"		Well graded saud; light brown, warse to Fine sand grains, about 5 or non-plastic fines (SW)	
70		S-14	22 40 60 60	TE WILLIAM	Silty clay; any Inorganic laminated with thin fine sand lances (CL)  End of Boring @ 72.0'	Borena = George To Surface
		- 2/ (2):			A-208	DS IS A PART

No. 3 Existing- size 5", depth 53', s.s.screen 15'

0-10 Yellow to light sand 10-23 Yellow to light gray sand 23-29 clay

23-30 Hard pan 30-58'10" Coarse gray water sand

Installed 1934 Replaced 1963 Installed submersible pump to sewer - 3/73 State order shut-downs 2/72, 6/73

<u> Mo 5</u> Existing- size 6", depth 54', s.s.screen 15'

0-10 Yellow to light sand Log: Installed 7/16/40 10-23 Yellow to light gray sand 23-29 clay 29-30 Hard pand Replaced 4/26/63 Shut-downs- 2/72, 6/73 30-58' 10" coarse gray water sand chay 58'10"- clary

No. 9 Existing- size 6", depth \$7', s.s.sczeen 10'

Logy 0-10 light yellow sand 10-23 light gray sand Installed 1912 Replaced- 7/40,6/48,11/53 23-30 clay with small portion gravel Shut-downs-2/72, 6/73 30- 57' 10" gray water sand

57' 10" - clay

No. 10 Existing- size 8", depth 61', s.s.screen 15'

0 -10 Brown sand and gravel Installed 1911 10-42 Lt. Brn. sand streaks white clay Replaced 7/26,1957,1963 Log: 42-47 white - yellow clay 47-65 Fine to coarse lt. brown sand Shut-downs-2/72,6/73 65-71 White sandy clay

No. 11 Existing- size 6", depth 52', s.s.screen 15'

0-13 Dirty yellow sand Log: 13-15 Gray sand 15-19 gray clay 19-27 Brown sand - gravel 27-40 gray sand 40-41 gray clay 41-46 Brown sand 46- 51' 8" gray clay

Installed 1911 Replaced 1952, 1963 Shut-downs 2/72, 6/73 Water Sample 1/1/63 Tot.Sol. 166 CO₃Hard. 5.5 Non-CO3 32.5 Tot.Hard. 38.0 Ca Hard. 26.C Chloride. 5.0

5.5

A-209

Free Carb.Acid(CO₂) 69.5

Alk.M.O.

## PERTH AMBOY SUCTION QLLS

No. 13 Existing- size 6", depth 50'?, s.s.screen 8"ml0'

LOg: Topsoil & sand 0-3 6**-**9 Gravel & sand 9-11 sand 11-1s sand, clay & gravel 13-21 sand, wood & clay 21-25 sand 26-23 sand & clay balls 28-35 sand pyrite & clay 35-40 coarse sand 40-50 coarse sand & clay balls 50-54 Brn. sand & clay balls 54-58 muddy sand & clay

Installed 1911
Replaced- 1/2/51, 6/27/57 Shut-down 2/72, 6/73

Existing- size 10", depth 38'+ Installed prior to 1934 screen L=21' Replaced- 1934, 1940 No. 4

NO LOG

12/1/70- Filled with iron & fibrous white jelly. Sounded to 38'-6" & shut down. SOURCE: WEHRAN 1989

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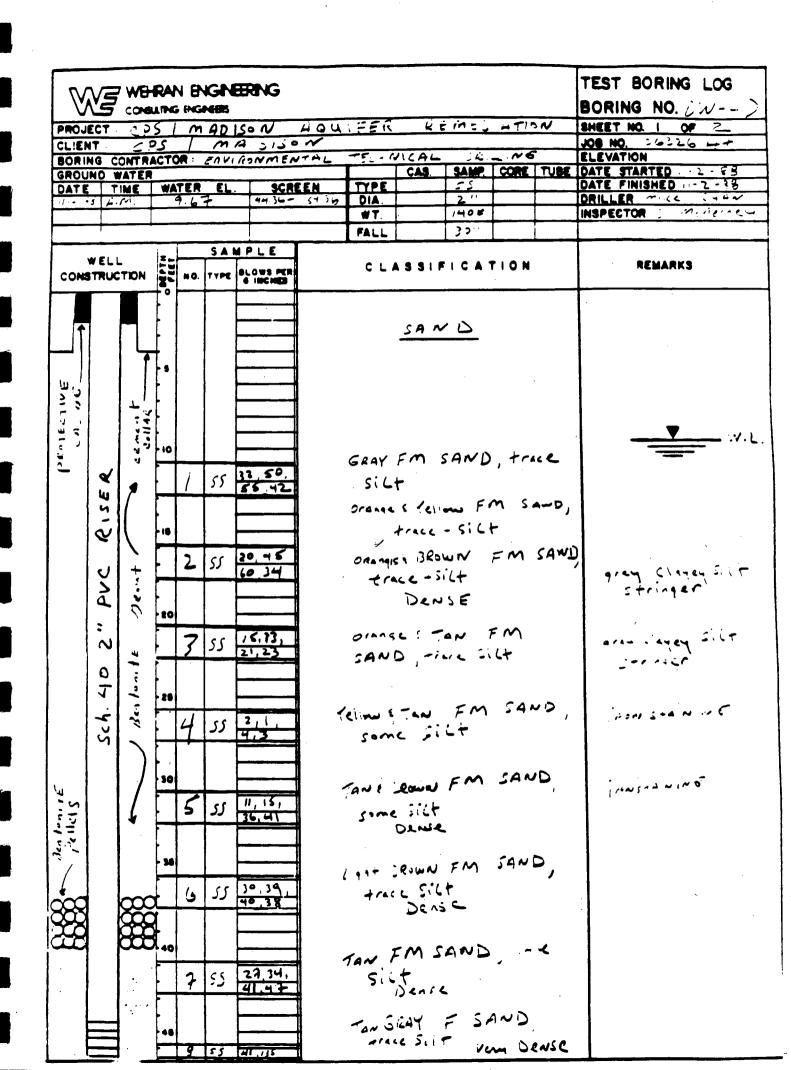
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# FURPOSES ONLY

STATE OF NEW JERSEY
SENT OF ENVIRONMENTAL PROTECTION
STATES OF WATER RESOURCES

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APPLICATION	
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#### WELL RECORD

OWNER CPS Chemical	Company	AČDRESS	P.O. Box 162	, Old Bridge,	::J
Cwner's Well No. WCC-1d		SURFACE ELS	VATION		•••
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6 Ja	n 81	.,, es J.E.	Fritts, Co.		
				101	Feet
Sch 40	PVC	Diameter	2 Inches	Length 91	Feet
CASING: Type Sch 40 P	VC0.0	20	2 Jaches	10	E
SCREEN: Type	Size of Opening	, Viameter			• •••
Range in Depth { Top Bottom				Rarita	<u>.</u>
Tail Piece: Diameter				••	
WELL FLOWS NATURALLY	Gallons per minut	te at	Feet above sur	rface	
Water rises to	Feet abov	e surface			
RECORD OF TEST: Date		Yield _	Gallons p	er minuts	
Static water level before pumpi	ing		Feet below surface	•	
Pumping level	feet below surface	after	hours p	umaing	
Drawdown	Feet Specific	Capacity	Gais, per min, per f	L of drawdown	<del></del>
Drawdown	_ Feet Specific	Capacity How m	Gals, per min, per f	L of drawdown	
Drawdown  How pumped  Observed effect on nearby well	Feet Specific	Capacity How m	Gals, per min, per f	L of drawdown	
Drawdown How pumped Observed effect on nearby well PERMANENT PUMPING EQUIP	Feet Specific s	Capacity How m	Gals, per min, per f	L of drawdown	
Drawdown  How pumped  Observed effect on nearby well  PERMANENT PUMPING EQUIP	Feet Specific	Capacity How m	Gals, per min, per f	L of drawdown	-
Drawdown  How pumped  Observed effect on nearby well  PERMANENT PUMPING EQUIP  Type  Capacity 6	Feet Specific  MENT:  MENT:  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELIN	Capacity How m	Gals, per min, per fineasured	L of drawdown	
Drawdown  How pumped  Observed effect on nearby well  PERMANENT PUMPING EQUIP  Type  Capacity  Depth of Pump in well	Feet Specific  MENT:  MENT:  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELIN	How m	Gals. per min. per fineasured  H.P.  H.P.	R.P.M	
Drawdown  How pumped  Observed effect on nearby well  PERMANENT PUMPING EQUIP  Type  Capacity 6	Feet Specific  MENT:  MENT:  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELINE  MODELIN	How m	Gals, per min, per fineasured  H.P.  H.P.	R.P.M  Feet SizeInches	
Drawdown  How pumped  Observed effect on nearby well  PERMANENT PUMPING EQUIP  Type  Capacity  Depth of Pump in well  Depth of Air Line in well	Feet Specific  MENT:  MENT:  Mar. M. How Driven  Feet Type	Depth of Footpic	Gals, per min, per fineasured  H.P.  H.P.	R.P.M  Feet SizeInches	
Drawdown  How pumped  Observed effect on nearby well  PERMANENT PUMPING EQUIP  Type  Capacity  Depth of Pump in well	Feet Specific  MENT:  MENT:  Mar. M. How Driven  Feet Type	Depth of Footpic	Gals, per min, per fineasured  H.P.  H.P.	R.P.M	
Drawdown  How pumped  Observed effect on nearby well  PERMANENT PUMPING EQUIP  Type  Capacity  Depth of Pump in well  Depth of Air Line in well  USED FOR MONITORING	Feet Specific  MENT:  MENT:  Mar. Maw Driven  Feet Type	Depth of Footpice of Meter on Pump	Gals. per min. per fineasured  H.P.  Average  Maximum  Sample: Yes	R.P.M Feet SizeInches Gallons Daily Gallons Daily No	
Drawdown  How pumped  Observed effect on nearby well  PERMANENT PUMPING EQUIP  Type  Capacity  Depth of Pump in well  Depth of Air Line in well  USED FOR  MONITORING  QUALITY OF WATER  Terre	Feet Specific  MENT:  MENT:  Mar. How Driven  Feet Type  Odor	Depth of Footpice of Meter on Pump  AMOUNT	Gals. per min. per fineasured  H.P.  Average  Maximum  Sample: Yes  To	R.P.M	
Drawdown  How pumped  Observed effect on nearby well  PERMANENT PUMPING EQUIP  Type  Capacity  Depth of Pump in well  Depth of Air Line in well  USED FOR  MONITORING  QUALITY OF WATER  Terre	Feet Specific  MENT:  MENT:  Mar. How Driven  Feet Type  Odor	Depth of Footpice of Meter on Pump  AMOUNT	Gals. per min. per fineasured  H.P.  Average  Maximum  Sample: Yes  To	R.P.M	
Drawdown  How pumped  Observed effect on nearby well  PERMANENT PUMPING EQUIP  Type  Capacity  Depth of Pump in well  Depth of Air Line in well  USED FOR MONITORING  QUALITY OF WATER  LOG descriptive	Feet Specific  MENT:  MENT:  Mar. Maw Driven  Feet Type  Odor	Depth of Footpice of Meter on Pump  AMOUNT  Color	Gals. per min. per fineasured  H.P.  Average  Maximum  Sample: Yes  furnish copy  Are samples available	R.P.M	
Drawdown  How pumped  Observed effect on nearby well  PERMANENT PUMPING EQUIP  Type  Capacity  Depth of Pump in well  Depth of Air Line in well  USED FOR  QUALITY OF WATER  Terre	Feet Specific  MENT:  MENT:  Mary May Driven  Feet Type  Odor  Van separate sheet If seets  Woodward-Clyd	Depth of Footpice of Meter on Pump  AMOUNT  Color	Gals. per min. per fineasured  H.P.  Average  Maximum  Sample: Yes  Are samples available finish copy.  Atts	R.P.M	

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tt. Selow Ground surface ______ A-232 completion.

Water level is ______

Baring No. BIA

### STATE OF NEW LERSEY END MIDNITORING DEPART SENTION OF WATER RESOURCES PURPOSES ONLY

APPLICATION NO. COUNTY Middlesex

#### WELL RECORD

CWNER CFS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NO CWNER Well No. WCC- 2M SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE ELEVATION ADDRESS FOR SURFACE E	CWNER CPS Chemic	al Company	ADDRESS	P.O. Box 162	, Old Bridge	, %3
DATE COMPLETED 20 Jan 81  DRILLER J.E. Fritts, Co.  DIAMETER: Top 6 inches 8 ontom 6 inches TOTAL DEPTH 56. Feet  CASING: Type Sch 40 PVC Diameter 2 inches Length 45 Feet  SCREEN: Type Sch 40 PVC Sits of Opening 0.020 Diameter 2 inches Length 10 Feet  Range in Depth 8 Feet Section 56 Feet Geologic Formation RATITATI  Tail Piece: Diameter Inches Length Feet Rest above surface  Water rises to Feet above surface  Water rises to Feet above surface  Water rises to Feet above surface  RECORD OF TEST: Date Yield Gallons per minute  Static water level before pumping Feet below surface after hours pumping  Drawdown Feet Specific Capacity Gals, per min, per ft, of drawdown  How pumped How measured  Observed affect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type GPM, How Driven Mfrs. Name R.P.M.  Depth of Pump in well Feet Depth of Footbiece in well Feet  Depth of Air Line in well Feet Type of Meter on Pump Size Inches  USED FOR MONITORING Gallons Daily  BUALITY OF WATER Ges Color Temp. OF.  Are samples evailable? Yes No Gallons Daily  DUACE OF DATA Woodward-Clyde Consultants	Capacia Wall No WCC-	- 2M	CHEFACE	EVATION		<u> </u>
DATE COMPLETED 20 Jan 81  DRILLER J.E. Fritts, Co.  DIAMETER: Top 6 inches 8 ontom 6 inches TOTAL DEPTH 56. Feet  CASING: Type Sch 40 PVC Diameter 2 inches Length 45 Feet  SCREEN: Type Sch 40 PVC Sits of Opening 0.020 Diameter 2 inches Length 10 Feet  Range in Depth 8 Feet Section 56 Feet Geologic Formation RATITATI  Tail Piece: Diameter Inches Length Feet Rest above surface  Water rises to Feet above surface  Water rises to Feet above surface  Water rises to Feet above surface  RECORD OF TEST: Date Yield Gallons per minute  Static water level before pumping Feet below surface after hours pumping  Drawdown Feet Specific Capacity Gals, per min, per ft, of drawdown  How pumped How measured  Observed affect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type GPM, How Driven Mfrs. Name R.P.M.  Depth of Pump in well Feet Depth of Footbiece in well Feet  Depth of Air Line in well Feet Type of Meter on Pump Size Inches  USED FOR MONITORING Gallons Daily  BUALITY OF WATER Ges Color Temp. OF.  Are samples evailable? Yes No Gallons Daily  DUACE OF DATA Woodward-Clyde Consultants	CHIEF S ITEM NO.		3URFACE EL	اهمنا	re mean sea .eve;;	••:
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Range in Depth   Top 46 Feet Geologic Formation	CASING: TypeSch 4	O PVC O	.020	2	10	F eet
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J. E. FRITTS & ASSCC. INC.

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Water level is ______ft. below Ground surface at compil A=234

Water level is _______ft. below Ground surface ______hrs. after completion.

Foreman E. H. 75 C. S. Baring No. F.- Z.

### STATE OF NEW LERSEY FOR MICHITORING DEPAY HENT OF ENVIRONMENTAL PROTECTION INVISION OF WATER RESOURCES FURPOSES, ONLY

APPLICATION NO. _ COUNTY Middlesex

#### WELL RECORD

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. OWNER CPS Chemical Company	AODRESSSC. SCX	102, Old 2011ge, NO
Cwner's Weil No. WCC-3D	SURFACE ELEVATION	ADDRE MOEN LEE . C. F.
DATE COMPLETED 6 Jan 81	_ DRILLER J.E. Fritts, Co	•
DIAMETER: Top 6 inches Botto	m inches TOTAL DEP	TH81ceet
CASING: Type Sch 40 PVC	Diameter 2 Inches	Length 84
CASING: Type Sch 40 PVC SCREEN: Type Sch 40 PVC Size of Opening	0.020 Uiameter !nches	Length 10
Range in Depth { Top Feet   Softom 81. Feet		
Tail Pisce: Diameter Inches	LengthFeet	
WELL FLOWS NATURALLY Gallons per (	minute at Feet ab	ove surface
Water rises to Feet	above surface	
RECORD OF TEST: Date	Yield Ga	llons per minute
Static water level before pumping	Feet below	surface
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Drawdown Feet Spet  How pumped  Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type G.P.M. How Or  Depth of Pump in well Feet  Depth of Air Line in well Feet  USED FOR MONITORING  QUALITY OF WATER  LOG descriptive  (Give arouse on best of short or an apparate short. If a	Mfrs. Name  How measured  Mfrs. Name  Type of Meter on Pump  AMOUNT  Amount  Sample: Yes  Color  Are samples ava	R.P.M.  Feet  SizeInches  Gallons Daily  Gallons Daily  No  TempOF.
Drawdown Feet Spet  How pumped  Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type G.P.M. How Or  Capacity G.P.M. How Or  Depth of Pump in well Feet  Depth of Air Line in well Feet  USED FOR MONITORING  QUALITY OF WATER  LOG descriptive  I Give avails on best of short or an apparate short. If a	Mfrs. Name  How measured  Mfrs. Name  Type of Meter on Pump  AMOUNT  Amount  Sample: Yes  Color  Are samples ava	R.P.M.  Feet  SizeInches  Gallons Daily  Gallons Daily  No  TempOF.

■ A-235

wa-31 J. E. FRITTS & ASSOC. INC. CLASSIFICATION 7 V 000 2 5/1 Ground Surface to tt. used 22 casing.

Mater level is _____tt. below Ground surface at completion. _tt. below Ground surface, hrs. after completion.

### FOR MONTORING PER JUSTICE WATER RESCURCES PURPOSES ONLY

987 V.T.		`-` `-	
		•	
APPLICATION			
	===	<u> </u>	Χ

#### WELL RECORD

OWNER CPS Chemica	1 Company		P.C. Box 16	2, Cld Bridge, NJ
Cwner's Well No. WCC- 6	55	SURFACE EL	EVATION	298 77940 784 (498)
100ATION		···		
DATE COMPLETED 12	Jan 81 0	RILLER J.E.	Fritts, Co.	
DIAMETER: Top 6 in	aches Bottom _	6 inches	TOTAL DEPTH_	80
CASING: Type Sch	40 PVC	Diameter	2 Inches	Length 65
CASING: Type Sch SCREEN: Type Sch 40	PVC Size of Opening 0.0	120 Diameter _	2 !nahes	LengthFeet
Range in Depth	75	Geologic Form	ition <u> </u>	Raritan
Tail Piece: Diameter	2 Inches	Length	Feet	
WELL FLOWS NATURALLY	Gallons per minu	te at	Feet above s	urface
Water rises to	Feet abov	e surface		
RECORP OF TEST: Date _	·	Yield.	Gallons	per minute
Static water level before pur	mping	·	Feet below surfa	<b>a</b>
Pumping level	feet below surface	after	hours	pumping
Drawdown	Feet Specific	Capacity	Gals, per min, per	ts, of drawdown
How pumped				
Observed effect on nearby v	vells			
PERMANENT PUMPING EQU	IIPMENT:			•
Туре	M	frs. Name		
Capacity	. G.P.M. How Driven		н.Р	_ R.P.M
Depth of Pump in well	Feet	Depth of Footb	iece in well	Feet
Depth of Air Line in well				
USED FOR <u>monitoring</u>	ıg	AMOUNT	Average	Gallons Daily Gallons Daily
QUALITY OF WATER			Sample: Yes	No
Tarre				
LOG descriptive	<u> </u>		Are samples available	e ves
SOURCE OF DATA				•
	Woodward-Clyd	e Consulta	nts : 12	2 Jan 81
DATA OSTAINED BY		·	Date	

WCC-6d

E. FRITTS & ASSOC. INC. Accres Chd Bridge, N. J. cand Surface this boring is _ DEPTH CLASSIFICATION Somele Deern 6-D me 16 6 Brown Fine To CONRS & Sand with Poblics 6 341 Braymad Sand 710 5-6. 10-41 391 Bray FINE myd SAND 15 Traces of silry clay 76-80%- 18 5% 57 Gray 15h white Fine SAND 420 a 4/60 5-7 10 10 71 741 Ligh T Brown Fine sand WITH LOYER OF SILTY CLAY 16 766 +0.6 Be. + Coay =/ sin +

A-238

Iround Surface to

Vater level is ______tt, below Ground surface at completion.

Foreman Francisco

Form DWR- 100 11-30

### STATE OF NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES

	23-12236
OF TIMES	

FOR	MONIT	CRINE
PIIR	POSES	ONLY

#### WELL RECORD

PERMIT	° ———
APPLICAT	TON NO
COUNTY	Middlesex

• (							
1. OWNER_	CPS Chemica	1 Company		p ADDRESS	.O. Box 162, 01	d Bridge, NJ	
Cwner's W	rell No. HCC- 11	đ		SURFACE EL	EVATION		= : , , ,
Z. LOCATION	N						_
4. DIAMETE	R: Top10in	ches	Bottom	10inches	TOTAL DEPTH	71.5 Length 55	Fee
5. CASING:	Type Sch 4	O PVC		Diameter _	2 Inches	Length55	F::
5. SCREEN:	Type	Size of C	O.U.	20" Diameter	Inches	Length	Fee
Range in	n Depth { Top_	55 m 65	Feet	Geologic Forma	RaritanFeet		·
Tail Piec	ce: Diameter	In	nches	Length	Feet		
. WELL FLO	OWS NATURALLY	Gall	ons per minut	e at	Feet above	surface	
Water ris	ses to		Feet above	surface			
. RECORD C	OF TEST: Date _			Yield	Gallon	ns per minute	
		-ai-a			Feet below sur	face .	
Static wa	ster level before pur	ubing		—— <del>—</del> —————————————————————————————————	Feet below 101		
		<del>-</del>			hou		
Pumping	g level	feet b	pelow surface (	ifter		rs pumping	
Pumping Drawdov	g level	feet b	selow surface (	ofter	hour	rs pumping	
Pumping Drawdov How pur	g level	feet b	Specific	Capacity How m	hour	rs pumping er ft. of drawdown	
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Pumping Drawdow How pur Observed PERMAINE: Type Capacity Depth of USED FOR	g level wn mped d effect on nearby w NT PUMPING EQU  f Pump in well f Air Line in well monitori	rells feet b	Specific (	Capacity  How reconstruction    Depth of Footpie of Meter on Pump  AMOUNT	Gals, per min. penessured  H.P.  Average  Maximum	R.P.M.  SizeInches  Gallons Daily  Gallons Daily	
Pumping Drawdow How pur Observed PERMANE: Type Capacity Depth of USED FOR	g level wn mped d effect on nearby w NT PUMPING EQU  f Pump in well f Air Line in well  Monitori  OF WATER	reit b reit b reit control feet b reit control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet control feet contr	Specific (	Capacity How in  Ins. Name  Depth of Footpic of Meter on Pump  AMOUNT	H.P.  Average  Maximum  Sample: Yes	R.P.M.  R.P.M.  SizeInches  Gallons Daily  No	
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J. E. FRITTS & ASSOC. INC.

JOB NO. 79 CO410 3 E

4-16-61								
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30' 21 Gard S.LT. 1/2 Ship		-	1 -	-	-	5		
27 33 GALLES MAT 13/2 SEL	3	3.5	30	41	7			
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- Lite	4	100	7,	7				
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47 46 Tan To BR. /- S.Liy		+						<del></del>
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41 54 7/ GRAY/P WIT SAND	-	+						<u> </u>
Sant S. LT	+	2/5	5' 1	24	10	28	39	0
54 64 6RAY 7 6 7 9200 UST		5/6	0	19	13	62	5%	0
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charge saw	2 9	7	2	71.6	17	26	29	-
67 716 GRAY ST. PE CLAY			•			<b></b>	<u> </u>	1
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__tr. below Ground surface at co

Boring stopped by-

____tt. below Ground surface_____ A-240 after completion.

Form DNR. 138

#### STATE OF NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES

<b>O</b>	23-1226
	PERMIT NO.
	APPLICATION NO.

## PURPOSES ONLY

#### WELL BECORD

23-1006	
ERMIT NO.	
APPLICATION NO.	
SOUNTY Micclesex	

	LOULDS OUT MET	
•	CPS Chemical Company	P.O. Box 162, Old Bridge, NJ  ADDRESS  SURFACE ELEVATION  (Above meen rea ever)
١.	Cwner's Well No. WCC - 12m	SURFACE ELEVATIONFiet
	LOCATION	
3.	DATE COMPLETED	ILLER J.E. Fritts, Co.
		O inches TOTAL DEPTH 56.5 Feet
z. E	CASING: Type Sch 40 PVC	Diameter 2 Inches Length 45 Feet 0" 10
J.	Sch 40 PVC 0.02	O"   2   Inches   Length   Feet
5.		
		Geologic Formation Raritan
	Tail Piece: Diameter Inches	LengthFeet
7.	WELL FLOWS NATURALLY Gallons per minute	et Feet above surface
	Water rises to Feet above	surface
8.	RECORD OF TEST: Date	Yield Gallons per minute
	Static water level before pumping	Feet below surface
	Pumping level feet below surface a	fter hours pumping
	Pumping level feet below surface a	
	Drawdown Feet Specific (	Capacity Gals, per min, per ft. of drawdown
	Drawdown Feet Specific (	Capacity Gals, per min, per ft. of drawdown  How measured
	Drawdown Feet Specific ( How pumped  Observed effect on nearby wells	Capacity Gals, per min, per ft. of drawdown  How measured
9.	Drawdown Feet Specific Company	Capacity Gals, per min, per ft. of drawdown  How measured
9.	Drawdown Feet Specific ( How pumped  Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type Mfr	Gals, per min, per ft. of drawdown  How measured
9.	Drawdown Feet Specific Company	Gals, per min, per ft. of drawdown  How measured
9.	Drawdown Feet Specific ( How pumped  Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type Mfr.  Capacity G.P.M. How Driven  Depth of Pump in well Feet	Tapacity Gals, per min. per ft. of drawdown  How measured  Ts. Name  H.P R.P.M  Depth of Footpiecs in well Feet
9.	Drawdown Feet Specific ( How pumped  Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type Mfr.  Capacity G.P.M. How Driven  Depth of Pump in well Feet	Tapacity Gals, per min. per ft. of drawdown  How measured  Ta. Name  H.P R.P.M  Depth of Footpiece in well Feet  of Meter on Pump SizeInches
	Drawdown Feet Specific (  How pumped Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type Mfr.  Capacity G.P.M. How Driven Peet  Depth of Pump in well Feet  Type Type of Feet	Tapacity Gals, per min. per ft. of drawdown  How measured  Ta. Name  H.P R.P.M  Depth of Footpiece in well Feet  of Meter on Pump SizeInches
	Drawdown Feet Specific ( How pumped  Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type Mfr.  Capacity G.P.M. How Driven  Depth of Pump in well Feet	Tapacity Gals, per min. per ft. of drawdown  How measured  Ta. Name  H.P R.P.M  Depth of Footpiece in well Feet  of Meter on Pump SizeInches
١٥.	Drawdown Feet Specific ( How pumped Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT:  Type Mfi  Capacity G.P.M. How Driven Peet  Depth of Pump in well Feet  Depth of Air Line in well Feet  USED FOR monitoring	Capacity Gals, per min, per ft. of drawdown  How measured  Ts. Name H.P R.P.M  Depth of Footpiece in well Feet  of Meter on Pump Size Inches  AMOUNT {  Average Gallons Daily  Maximum Gallons Daily
١٥.	Drawdown Feet Specific ( How pumped  Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type Mfr.  Capacity G.P.M. How Driven  Depth of Pump in well Feet  Depth of Air Line in well Feet  USED FOR monitoring	Capacity Gals, per min. per ft. of drawdown  How measured  Ta. Name  H.P R.P.M  Depth of Footpiece in well Feet  of Meter on Pump Size Inches  AMOUNT {
10.	Drawdown Feet Specific ( How pumped  Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type Mfr.  Capacity G.P.M. How Driven  Depth of Pump in well Feet Type  USED FOR monitoring  QUALITY OF WATER  Taste Odor	Gals, per min. per ft. of drawdown  How measured  H.P. R.P.M.  Depth of Footpiece in well Feet  of Meter on Pump Size Inches  AMOUNT {
10.	Drawdown Feet Specific ( How pumped  Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type Mfr.  Capacity G.P.M. How Driven  Depth of Pump in well Feet Type  USED FOR monitoring  QUALITY OF WATER  Taste Odor	Capacity Gals, per min. per ft. of drawdown  How measured  Ta. Name  H.P R.P.M  Depth of Footpiece in well Feet  of Meter on Pump Size Inches  AMOUNT {
10. 11.	Drawdown Feet Specific ( How pumped Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type Mfr.  Capacity G.P.M. How Driven Mercapacity Feet  Depth of Pump in well Feet  Depth of Air Line in well Feet  Type Odor Odor  LOG descriptive Odor SOURCE OF DATA Woodward-Clyde Consult	Gals, per min. per ft. of drawdown  How measured  H.P. R.P.M.  Depth of Footpiece in well Feet  of Meter on Pump Size Inches  AMOUNT Average Gallons Daily  Maximum Gallons Daily  Sample: Yes No  Color Temp. OF.  Are samples available? Yes  Are samples available?
0.	Drawdown Feet Specific ( How pumped Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type Mfr.  Capacity G.P.M. How Driven Mercapacity Feet  Depth of Pump in well Feet  Depth of Air Line in well Feet  Type Odor Odor  LOG descriptive Odor SOURCE OF DATA Woodward-Clyde Consult	Gals, per min. per ft. of drawdown  How measured  H.P. R.P.M.  Depth of Footpiece in well Feet  of Meter on Pump Size Inches  AMOUNT Average Gallons Daily  Maximum Gallons Daily  Sample: Yes No  Color Temp. OF.  Are samples available?  Yes

WCC-12 m 100 No. 29COLIO? J. E. FRITTS & ASSOC. INC. old Rodac 15. Fred Datum used is .... 3 bund Surface this boring is ---No 31 30: Slowe on Spoon! 20:0+4++ Semble Seath CLASSIFICATION 310 6 1 1 1 6" 1 2~ 5 **9**5 15 05 10/11/6 END

Ground Surface to.

... ft. below Ground surface at completion.

_ ft. below Ground surface ___ A-242 irs. after completion.

Boring stopped by-

Foremen Forma Com

Baring No. 12 _____

:	=:	-	INA.	1;	ţ
	٠	3.3			

#### STATE OF NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESCURCES

	3						
AMIT NO.	_	_	_	_	_		 _

SERMIT NO.	
APPLICATION NO	
Middlesex	

: CWNERCPS Chemical Company	P.O. Box 162, Old Bridge, NJ
WCC- 13m	SURFACE ELEVATION
2. LCCATION	J.E. Fritts. Co.
B. DATE COMPLETED DO ANY DI	10 55.5 See
DIAMETER: Top 10 inches Bottom _	inches TOTAL DEPTH 44
S. CASING: Type Sch 40 PVC 0.0	10   inches
Size of Opening	Diameter Inches Length Feet
Range in Depth    Top Feet    Softom Feet	Geologic FormationRaritan
Tail Piece: Diameter Inches	LengthFoot
. WELL FLOWS NATURALLY Gallons per min	ute at Feet above surface
Water rises to Feet abo	
RECORD OF TEST: Date	
Static water level before pumping	Feet below surface
Pumping level feet below surfac	e after hours pumping
Drawdown Feet Specifi	ic Capacity Gals, per min, per ft, of drawdown
How pumped	How measured
How pumped	How measured
Observed effect on nearby wells	How measured
Observed effect on nearby wells	How measured
Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type	Mfrs. Name
Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type  Capacity G.P.M. How Drive	Mfrs, Name
Observed effect on nearby wells	Mfrs. Name  H.P. R.P.M.  Depth of Footpiece in well Feet
Observed effect on nearby wells	Mfrs. Name  H.P. R.P.M.  Depth of Footpiece in well Feet  rpe of Meter on Pump Sizeinches
Observed effect on nearby wells	Mfrs. Name  H.P. R.P.M.  Depth of Footpiece in well Feet  rpe of Meter on Pump Sizeinches
Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type  Capacity G.P.M. How Drive  Depth of Pump in well Feet  Depth of Air Line in well Feet  USED FOR monitoring	Mfrs. Name  H.P. R.P.M.  Depth of Footpiece in well Feet  The of Meter on Pump Size Inches  AMOUNT  AMOUNT  Maximum Gallons Daily  Maximum Gallons Daily
Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type	Mfrs. Name  H.P. R.P.M.  Depth of Footpiece in well Feet  The of Meter on Pump Size Inches  AMOUNT Average Gallons Daily  Maximum Gallons Daily  Sample: Yes No
Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type  Capacity G.P.M. How Drive  Depth of Pump in well Feet  Depth of Air Line in well Feet  USED FOR monitoring  1. QUALITY OF WATER Odor	Mfrs. Name  H.P. R.P.M.  Depth of Footpiece in well Feet  The of Meter on Pump Size Inches  AMOUNT  AMOUNT  Maximum Gallons Daily  Sample: Yes No Color OF.
Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type  Capacity	Mfrs. Name  H.P
Observed effect on nearby wells  PERMANENT PUMPING EQUIPMENT:  Type	Mfrs. Name  H.P. R.P.M.  Depth of Footpiece in well Feet  pe of Meter on Pump Size Inches  Awerage Gallons Daily  Maximum Gallons Daily  Sample: Yes No  Color Temp.  Are samples available?  yes  ull tants

wcc-13m 100 No 79 C 84/C3 J. E. FRITTS & ASSOC. INC. No of 30" blows on Spoon account aund Surface this borned s -CLASSIFICATION 1st 6" | 2nd 6 TVD4 THE GOLF FTE 2 14 114 -L. 30 . 71.6 15 3.5 .61 574 70 3/ 5,17 -10 1: Foremand Soul Co. Soring No. 3 _ 17. used _ Ground Surface to ___ _tr. below Ground surface at ( _ ft. below Ground surface ____ A-244 s. after completion.

Boring stopped by-

DEL DEPARTMENT OF ENVIRONMENTAL PROTECTION BORING NO. Well ST-1 DIVISION OF WATER RESOURCES BUREAU OF GROUND WATER MANAGEMENT ELEVATION DATE STARTED 10/20/32 PROJECT CPS-Madison PURPOSE DATE FINISHED 10/20/82 LOCATION East of Pond WATER LEVEL ____ DATE ____ TIME ___ HELPER INSPECTOR OR J. Curran GEOLOGIST DRILLER TYPE OF DRILLING Hollow stem Auger H. Larason SAMPLE ELEV-CASING CASING FOOT FOOT WELL CLASSIFICATION ' REMARKS SPOON BLOW 6" PENE. DESIGN *0* ELEV. =____ Threaded 2" P' pipe and scree 20 slot No Samples Ta 20" PVC 20 slot

A-245

DEPARTMENT OF ENVIRONS TAL PROTECTION BURING NO. Well #ST-2 DIVISION OF WATER RESOURCES BUREAU OF GROUND WATER MANAGEMENT ELEVATION DATE STARTED 10/20/82 PROJECT CPS-Madison PURPOSE Monitor DATE FINISHED 10/22/82 LOCATION East of Pond WATER LEVEL DATE TIME HELPER INSPECTOR OR
J. Curtan GEOLOGIST TYPE OF DRILLER DRILLING Hollow Stem Auger H. Larason SAMPLE ELEV-CASING MOITY FOOT FOOT WELL CLASSIFICATION ' REYARKS SPOON BLOW DESIGN *0* ELEV. -____ Threaded 2" PV pipe 20 slot P screen. No Samples Tak-2" PVC Pipe 2" PVC Screen 20 slot A-246

DEPARTMENT OF ENVIRONM .TAL PROTECTION BORING NO. Well #ST-1 DIVISION OF WATER RESOURCES BUREAU OF GROUND WATER MANAGEMENT ELEVATION DATE STARTED 10/27/82 PROJECT CPS-Madison PURPOSE DATE FINISHED 10/27/82 LOCATION South of Pond WATER LEVEL DATE TIME TYPE OF DRILLER HELPER INSPECTOR OR DRILLING Hollow Stem Auger H. Larason M. Ryan GEOLOGIST SAMPLE ELEV-FOOT FOOT WELL CLASSIFICATION ' REYARKS SPOON BLOW DESIGN "0" ELEV. -____ 2" PVC Pipe 2" screwed and c PVC 10' 20 slot : Pipe No Samples 10ft 2" PVC screen A-247

## APPENDIX A-7 ANALYTICAL RESULTS (PRIOR TO 1988)

RANGE OF CONSTITUENTS DETECTED IN ALL WELLS (ppb)

				RA			UENTS D	ETECTED IN		Cadmium	")		
	Zinc			Lead				Cadinium					
		<u>-</u>	***	Data	Low	Date	High	Date	Low	Date	High	Date	
Wells	Low	Date	High	Date 9/12/77	2	10/75	555	5/77	11	4/76	1700	9/12/77	<del></del>
M-1	6340	11/75	625000	10/77	1	9/12/77	948	3/87	28	5/77	2010	3/82	
M-2	6500		1660000 27250	9/24/75	1.	9/12/77	76	10/77	2	+ 10/77	41	4/76	
M-3	220	5/83	36250	8/75	1	9/24/75	16	8/76	1	11/75	16	8/75	
M-4	80.	5/83 5/77	4200	8/75	2	9/24/75	24	8/76	2	11/75	. 12	8/75	
M-5	100	11/88	17000	5/83	5	3/87	14	11/88	15	3/87	130	5/85	
M-6	3410 360	10/79	97700	8/77	4	9/12/77	360	10/79	1	9/6/77	10	8/77	
S-1	328	8/77	800	9/12/77	9	9/12/77	328	8/77	2	8/77	6	9/12/77	
S-2 S-3	1225	9/6/77	3100	9/12/77	16	9/12/77	110	10/77	5	9/6/77	. 9	8/77	
3-3 A	4830	3/82	515000	5/75	5	3/87	52	10/77	. 5	3/87	41	9/12/77	
B	199	9/6/77	45000	5/83	3	9/24/75	18	3/87		& 5/85	1.1	5/75	
C	216	3/82	3250	6/75	3.	11/75	117	9/6/77	2	11/75	6	6/75	
8	1050	6/75	20050	5/75	8	* 10/77	82	5/75	11	( 9/12/77	25	5/75	
B	167	9/6/77	7440	5/75	3	9/24/75	18400	4/76	1	8/76	26	5/75	<u> </u>
F	217	9/6/77	2600	9/24/75	5	6/75	69	11/75	11_	4/76	13	5/75	
G	214	9/6/77	3450	11/75	1	9/12/77	15	9/6/77	1	11/75	17	5/75	
8	430	11/75	1120	5/75	10	5/77	103	5/75	1	@ 8/76	5	9/24/75	<del></del>
NO.1	1600	6/75	2400	5/75	6	6/75	- 14	5/75	10	6/75	17	5/75	
NO.2	465	10/77	465	10/77					1			EITE	
NO.3	4960	5/75	78750	2/74	3		41:-	5/85	2	10/77	31	5/75	<u>a</u>
NO.4	360	5/76	5300	4/76	2	5/76	3	4/76	1	5/76		4/76	
NO.5	10	4/76	10:	4/76	2		.3.,	4/76	3		70	5/85	
NO.10	962	3/82	8125	5/85	63	5/85	342	3/82	1	5/85	1.	3/63	
NO.11	1250	3/82		3/82	34		34	3/82	3	4/76	126	3/82	
NO.12	97000	5/83	156000	3/82	2	4/76	6920	3/82	3	4//0	120	3/02	
NO.13						417.6	<u> </u>	4/76	21	4/76	21	4/76	
NO.16	404	3/82	1200	4/76	3	4/76	3	4//0	21	4//0			
NO.18			<u> </u>			2/00	24	3/82					
NO.19	562	3/82		3/82	24	3/82 11/88	30	3/82	+		. 4.6	<del></del> <del>-</del>	
WCC-IM	428	11/88		3/82	13	11/88	74	3/82	6	3/82		3/82	
WCC-ID	423	3/82		11/88	1.4	11700	1 1 1 1 1 1 1		+	<u> </u>		··	
WCC-2	1310	11/88		11/88 3/82	51	3/82	51	3/82	21	3/82	21	3/82	
WCC-2M	428	3/82		2 - 2	40		40	3/82	9	3/82	9	3/82	
WCC-3M	424	11/88		3/82 11/88	3		71	3/82			100		
WCC-3D	351	3/82		3/82	30		30		8	3/82			
WCC-4S	950	3/82			203		203	3/82	7	3/82	. 7	3/82	
WCC-4M	3820	3/82			1205						1.45		
WCC-5S	288 486	3/82			1.4		22	3/82	6	3/82	6		
WCC-6S WCC-6M	259	11/8			7.8		74	3/82	34	3/82	2 34		
WCC-6D	1040	3/8			206			3/82	12				
WCC-7M	1610	3/8:			30	3/82			19				
WCC-9S	1800	5/8:			5	3/87				3/87			
WCC-9M	1988				5	3/87				3/81			
WCC-9D	11200				40	3/82			22				
WCC-IIS	6970	11/8			2.5	11/88	61		4			3/87	
WCC-11M	-				3.8	11/88			3				
WCC-IID		3/8			×:5	3/87							
WCC-12M	333				3.9				_   -	3/8	2 4	3/82	
WCC-13	174			5/83	3.2					· <u> </u>		2.00	
WCC-14S	161		32 800	5/83	71				1				
WCC-15SE				3/82	78	3/82	2 78	3/82		4 3/8		4 3/82	
WCC-I5M				5/83								2/82	
WCC-15D	149			3/82	7					9 3/8		9 3/82	
WCC-168	170		33 7100	11/88	2.				_   _	3 3/8	12	3 3/82	
L-1A						1 4/7:	3 10	3/73				<del> </del>	
L-2	25	3/	73 25	3/73					_				
L-3			+ + 4			5 4/7:					72	2 5/73	
L-4	250	4/	73 15000	5/73		4 # 2/7	4 11	3/73		1. 3/7	13	2 5/73	
								*					

RANGE OF CONSTITUENTS DETECTED IN ALL WELLS (ppb) (Continued)

	Zinc					ead			C	admium		
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
L-5	150	4/73	220	2/74					2	3/73	2	3/73
T-1	28540	3/87	289600	5/85	- 5	-3/87	375	5/85	- 12	5/85	1694	3/87
DEP.I	378	11/88	378	11/88	2	11/88	2	11/88	i 85 m.i			
DEP-2	354	11/88	354	11/88	1.1	11/88	1.1	11/88				
DEP4	7660	11/88	7660	11/88	7	11/88	7	11/88	17	11/88	17	11/88
DW-1S	903	11/88	903	11/88	1. 1. 2.		200					
DW-ID	95	11/88	95	11/88			ali va va					
DW-25	659	11/88	659	11/88					V.			
DW-3S	521	11/88	521	11/88			.y., - 191					-
DW-3D	88	11/88	88	11/88			1 1		1 1			
DW-48	1090	11/88	1090	11/88					3.775	·		
DW4D	207	11/88	207	11/88	Livin		1.6 W. T.		ni sajad			
DW-SS	2140	11/88	2140	11/88		· · · · · · · · ·	vartiki e		See At 1			
DW-5D	47	11/88	47	11/88	1.54	,			Set 1		1	
DW-68	945	11/88	945	11/88	0.98	11/88	0.98	11/88	1. W.			
DW-6D	151::	11/88	151	11/88	5.5	11/88	5.5	11/88			JAMES TO	
DW-75	108	11/88	108	11/88	127. oz. ¹		1		1. 1. (1. (1. (1. (1. (1. (1. (1. (1. (1. (			
DW-7D	65	11/88	65	11/88			. 14		. +5.		7 N	
SAY-PRO A	101	5/85	101	5/85	. 6	5/85	6	5/85	1.	5/85	1	5/85
PA-05	1 1 Mg.						View Control		J. 28 3		najajnjihu.	
			14.14		Zianika Kanaka		W.J.F		er jekjá		was it is	
FB-1	47	11/88	25151	3/87	1.2	11/88	25:	3/87	5	3/87	.5.	3/87
FB-2	26	11/88	26	11/88	1,745		8. A		1.19 b			
FB-3	26	11/88	26	11/88	3.2	11/88	3.2	11/88				
FB-4	e et ligits		100000		- 4		1. 4.		dii.			
ГВ-1	51	3/87	51	3/87	43	3/87	43	3/87	5	3/87	5	3/87
ГВ-2	T Makes								1,21,13,			
ТВ-3			1 1				2 11		74.			
TB-4		-							100		. 1	,
MB	14	<u></u>	mi Yan									

NOTES: When HIGH=LOW, only one sample was taken

"SAY-PRO A" and "PA-05" wells are production wells

Shaded wells represent selected wells

- * = Well D also had a low of 8 on 5/75
- # = Well L-5 also had a low of 4 on 4/73
- + = Well M-3 also had a low of 2 on 5/77 and 11/75
- & = Well B also had a low of 1 on 11/75
- @ = Well H also had a low of 1 on 11/75
- a = two readings were averaged to obtain this value

٠		Сорре	r		. N	Aethylene	cloride		1,1,2,2	-tetrachl	oroethane	;
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1	870	1983		1982	73	12/78	73	12/78	1.1	12/78	10	10/79
4-2	1689	1987	24000	1988	16	11/88	160	10/79	54	10/79	54	10/79
M-3	120	1983	120	1983	120	4/76	83000	10/79	240	12/78	4510	10/79
M-4		1987		1987	20				1.3	12/78	1.3	12/78
M-5		1987		1987	1.2	12/78	1.2	12/78				
M-6	3200			1987	430	11/88		11/88			· .	
S-1	3200	1705	100		850	9/12/77	67000			12/78	8430	10/79
S-2			<u>&amp;</u>	**		J. 12	0,000	10///	- 0000	12,.0		10,77
3-2 3-3					2.4	12/78	2.4	12/78	<u> </u>			
	15	1007		1983	10	10/79	48.2	10/78		12/78	13.7	10/78
A	15								49	5/85	8400	12/78
B		1985		1987	1400	5/85	391000	10/78		3/63	0400	12//0
C	10	1982	10	1982	4.8	7/78	4.8	7/78	- 0.4	10/70	0.4	10/79
D				·	0.4	7/78	0.4	7/78	0.4	12/78	0.4	12/78
6			: 1,1		17	10/79	<del></del>	10/79	1.6	12/78	1.6	12/78
F				<del>, .</del>			100					
g	L		·: ·									
B			1 2	· · · · · · · · · · · · · · · · ·			5 - 5 ° 1.		<u> </u>		- 15 <u>- 1</u>	
NO.1	:				257	10/78	257	10/78	3.3	12/78	3.3	12/78
NO.2									ŀ			
NO.3	171	1985	a 171	1985	4.6	10/78	42	7/78				
NO.4					1:7	10/78	1.7	10/78				
NO.5					7.2	10/78	7.2	10/78				
NO.10	11	1985	13	1982	1230	10/78	1230	10/78	:			
NO.11	1	1982		1982	2.4	3/82	21330	10/78	1677	10/78	1677	10/78
NO.12	53600			1982	1200	5/85	17000	3/82	:1.0			
NO.13				:			- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1		94	5/85		5/85
NO.16	, 19.6%		•	·	13	7/78	14	10/78	a gar.			
NO.18			<u> </u>		2.7	10/78	2.7	10/78	<del>                                     </del>			
NO.19	<u> </u>	1982	21	1982	1.5 %			··•				
WCC-IM	1	1982		1988		<del> </del>	<u> </u>			3/87	11	3/87
WCC-IM	<del></del>	1988		1982						5,01		3,01
	33	1300	30		1.08 3.25	<del></del>	(4,8114)					
WCC-2		1000										
WCC-2M	-	1988		1982	- 2004 - 2004	<del></del>						
WCC-3M	1	1988	<del></del>	1982			* 5					
WCC+3D		1988		1982								
WCC-4S		1982		1982			18633					
WCC-4M	<del></del>	1982		1982	Turi.				<u> </u>		5.14	
WCC-5S	. 25	1982		1982			. 1 A A.			·		
WCC-6S	65	1988	a 105	1982	3845	3/82	3845	3/82				
WCC-6M	33	1988	256	1982	. 26.540							
WCC-6D	91	1982	91	1982	gji filiti s		1 1198					
WCC-7M	874	1982	874	1982	9.8	3/82	9.8	3/82	200			
WCC-9S	36	1987	101	1982			214.7					
WCC-9M	3672	1987	6900	1983	680	3/87	680	3/87	- 1			
WCC-9D	2850			1982	218	3/82	218	3/82	1			
WCC-IIS	15			1982								
WCC-HIMN	1					. 2					······································	
WCC-IIDC	+	1987		1982			1000				<del></del>	
WCC-12M	1	1988		1982	960	3/87	960					
	<del></del>				700	3/0/		5/0/				
WCC-13	<del></del>	1988		1988			100 AT	<del></del>				
WCC-148	<del></del>	1982		1982	<del></del>				<del>   </del>			<b>2</b>
WCC-15SE	61	1982	61	1982	34	3/82	18000	5/85	63	5/85	63	5/85
WCC-I5M												
WCC-15D	140	1982	140	1982	26.7	3/82	26.7	3/82	20.3	3/82	20.3	3/82
100000000000000000000000000000000000000	74	1982	74	1982	7.9	3/82	7.9	3/82	30	3/87	30	3/87
WCC-163					1							
L-1A												
<u> </u>	1				A-2"	51	-					
L-1A					A-25	51						

	Copper			lethylene cl	loride		1,1,2,2	tetrachl	oroethane	
Wells	Low Date	High Date	Low -	Date	High	Date	Low	Date	High	Date
L-5	The Second	great to the			10.4					
T-1	6700 1983	24230 1987	69	5/85	140	3/87	3	5/85	3	5/85
DEP-I	18 1988	18 1988	2	3/87	2	3/87	2	3/87	. 2	3/87
DEP-2	4.3 1988	4.3 1988	59	3/87	59	3/87				
DEP4	66 1988	66 1988	n. Eye.		<del>.</del>					_
DW-1S	Taraya 6	Sket#			all s					
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DW-2S	5.5 1988	5.5 1988	457	į.	îşurdê.	+				
DW-3S	r deficie	A see to			er Burge					
DW-3D	11									
DW48	11 1988	11 1988								
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DW-5D		-,	100		* * * *		39	11/88	39	11/88
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DW-7S	F.A.		w		· .				igray)	
DW-7D	· In	it seek si	41 3 7		fer " E		59	11/88	59	11/88
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FB-2	5.5 1988	5.5 1988	7.		5 J.					
FB-3			1.5		-812 A		112.41			
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	1,2-dich	loroeth	ane		1,1-dich	loroeth	ane		1,1-di	cholor	ethene		Carbon	tetrachl	oride	
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1	6.5	3/82	6.5	3/82					-		6					
M-2	53	3/82		11/88	<del>                                     </del>											
M-3					13	4/87	13	4/87								
M-4																
M-5	1		1.0										1			
M-6	670	11/88	670	11/88												<del></del>
S-1													<u> </u>			
S-2			•										-			
8-3					110	4.05		4/07					9.2	3/82	9.2	3/82
<u> </u>	6.8	3/82	6.8	3/82	640	4/87 5/85	640	4/87 5/85	3	5/85	3	5/85	6.5	5/85	6.5	5/85
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NO.12	770	5/85		3/82	2	5/85		3/82	3	5/85	3	5/85	1750	3/82		3/82
NO.13	,,,		y.4					<u> </u>								
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WCC-ID	16	3/82		3/82	<del>                                     </del>							2	<del>  "</del>	3,02		
WCC-2 WCC-2M							<del></del>									
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WCC-4M							136									
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WCC-6D	28	11/88	28	11/88	16.9		2 16.9	3/82		:		•	17.3		17.3	
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L-3	+			<del> </del>			A-	253 —								
<u>L4</u>																

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Wells	Low Date High Date	Low Date High Date	Low Date High Date	Low Date High Date
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M-6					-							<del></del>
S-1			Angelone (S.) Additional				<del></del>		3 1 2 3			
S-2 3-3												
	18	3/82	18	3/82	4.5	3/82	4.5	3/82	9.8	3/82	9.8	3/82
A B	10	3/02	- 10	3/62	60	4/87	60	4/87	29	4/87	29	
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NO.10			*									
NO.11	11	3/82	11	3/82	3.8	3/82	3.8	3/82	2.5	3/82	2.5	3/82
NO.12	2600	3/82	2600	3/82	655	. 3/82	655	3/82	2130	3/82	2130	3/82
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NO.18												
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WCC-5S	-17.1				194	3/82	194	3/82	. 68			
WCC-6S	205	3/82			60	3/82	125		314		2 795	3/82
WCC-6M			24 - 27		7						- 7	·.
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WCC-7M						.:	<u> </u>		124		2 124	
WCC-9S	CDalg-Ri.	·					·					
WCC-9M		ė.	2 3 4 3 5 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5									
WCC-9D	ģSv.									·		A/97
WCC-IIS	32				7.6				5.8			<del> </del>
WCC-IIMN	<u> </u>	3/82	131	3/82	3.3				9.1			
WCC-IIDC			, 1		1.1				200		. 2000	
WCC-12M					120	11/88		<del></del>		11/8	8 3000	4/87
WCC-13						<u> </u>						
WCC-14S		····							1.		0 50	4/07
WCC-15SE	97	3/82	97	3/82	20.3	3/82	2 190	4/87	42			
WCC-15M									5			
WCC-15D	73	3/82	2 73	3/82	15.1	3/82	2 15.1	3/82	45	3/8	2 45	3/82
WCC-168						_						
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L-2	٠.						_					
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L-5	ga ringgaya.		estatus Parasteit	据 [4] [4] [4] [4] [4] [4] [4] [4] [4] [4]
T-1	8,8% g/W		3 5/85 3 5	/85
DEP-I			0.6 3/82 0.6 3	/82 4/87 1 4/87
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DEP4			A Things	
DW-1S		X High	Wilder College	
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DW-25		1.4 %		
DW-3S	Lindia		enisea matala	
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	Bis(2-et	hylhexy	l)phthal	ate	1,2-dich	loropro	pane		Chlorob	enzene		
Wells	Low	Date	High	Date	Low -	Date	High	Date	Low	Date	High	Date
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<u>1-3</u>									17	4/87	17	4/87
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3-3					2.2	3/82	2.2	3/82	<del></del>		<u> </u>	
A	1,576		Tart a con-			5/85	3.8	5/85	110:	4/87	300	5/85
B	1 222		145 414		3.8	3/63		2/03	110	4/0/		3/83
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NO.1	<b></b>											
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NO.4												
NO.5	44.07		Jana Jana								<u> </u>	
NO.10							- 15 - 1				T. 7	
NO.11			14		2.9	3/82	2.9	3/82	F 5.11		F. 1.21.	
NO.12	etal u		1,7,1		10	5/85	375	3/82	26.9	3/82	300	5/85
NO.13			XYEAR		1248 1				4.7	·		
NO.16	11,40,00		122						1		4	••
NO.18	112 113		100		-		+1.5		- 1		•	
NO.19	32	3/82		3/82					.:*			
WCC-IM	22	3/82	22	3/82	6	3/82	6	3/82				
WCC-ID	36	3/82	36	3/82				-	1.	-	.:	
WCC-2			14,211928									
WCC-2M	43	3/82	43									
WCC-3M	75				1, 1,		A in or	<del> </del>			7, 11	· · · · · · ·
WCC-3D												
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WCC-4S	42				1999				1177			·
WCC4M		3/82		3/82			100	2/92				
WCC-5S			Sugar-194		129	3/82	129		30		115	
WCC-6S	42				101		122		32	3/82	115	3/82
WCC-6M			<u> </u>		3.2	3/82	3.2	3/82				
WCC-6D	27		27		24	2.00	\$* a a.	3/00		2/02	2.0	2/92
WCC-7M	37		37		34	3/82	34	3/82	3.8	3/82	3.8	3/82
WCC-9S										•		
WCC-9M	100								* *			
WCC-9D	24		24		:			<u> </u>			31.33 31.34	
WCC-IIS	175				4.2	3/82	4.2	3/82	4.5			4/87
WCC+I1MN	(1)		1.5 %		m N				1.	<u> </u>		
WCC-HDC			High va						-4.5		11 j i i i	
WCC-12M	3.77		15 144		5.1		1.44		900	4/87	1100	11/88
WCC-13					-							
WCC-14S	1		1									
WCC-15SE					11.6	3/82	24	5/85	100	5/85	580	4/87
WCC-I5M												
WCC-15D	88				17.2	3/82	17.2	3/82	3.9	3/82	3.9	3/82
WCC-15B	-		<del></del>		12	J. 02		J. <b>J.</b>	1			<del></del>
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L-IA	<u> </u>	<u> </u>								<del> </del>	<u> </u>	
L-2			<u>Tha</u>		A-257				-			
L-3									_			
L4			: ''			_					4	

	Bis(2-eth	ylhexyl)	phthala	ite	1,2-dich	hloroprop	anc		Chlorobenzene			
Wells	Low	Date F	ligh	Date	Low	Date	High	Date	Low	Date	High	Date
L-5	in Anale				h. v *·.				41.77			
T-1	7.750-1		lest.				4				4 6	
DEP-1	lojeli.	18			\$ · .		· V · CV ·					
DEP-2	se jaja kij	Fig.	Sagara.		1			-	290	4/87	460	11/88
DEP4	in the f		guja, s		<b>44</b> (1)							
DW-1S	1 11	54. 6.1.			121, 1				22	11/88	22	11/88
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DW-25	i et jaren		jime s		s e Marjer		House t					
DW-3S	 1 - 1 - 124		4.		4.1.4						47.1	
DW-3D			. 59		·							
DW4S	garan g		:				:	· · · · · · · · · · · · · · · · · · ·		-		
DW4D											-:-	
DW-5S	. 18		. 3						290	11/88	290	11/88
DW-5D									59	11/88	59	11/88
DW-68												
DW-6D								<del></del>			: +	<u>-</u>
DW-7S			7		×				and a fit			
DW-7D	Sir M								580	11/88	580.	11/88
SAY-PRO A		:							1.1		:	
PA-05			(				· · · · · · · · · · · · · · · · · · ·					
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FB-1			1	-	1.0				1,14			
FB-2	A, 1.						į.				di.	
FB-3	<u> </u>		5.0					·				
FB-4	district	i y					1	· · ·				
TB-1		A 1					4. TE					
ГВ-2	er e				100		200	<del></del>				
ГВ-3		٠.			KI				13		2	
TB-4	va Jir		110 9000				1.14					
МВ	60	3/82	60	3/82								

	Trans-1	,2-dich	loroethyl	lene	Ethylbe	nzene			Total x	vienes			1,1,1-tr	ichloro	ethane	
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1			· · · · · · · · · · · · · · · · · · ·										2.6	3/82	2.6	3/82
M-2			·		17	3/82	17	3/82	10	3/82	10	3/82	3.7	3/82	3.7	3/82
M-3	30	4/87	30	4/87	1.44									<del></del>		<del></del>
M-4			1.00													
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M-6			9, 3,7		71.5											
S-I					el suga											
S-2	44.55		11 10 10 10 10 10 10 10 10 10 10 10 10 1				· · · · ·								··	
3-3		2:22	· *,	2.22												
A	26.4	3/82	26.4	3/82	3.9	3/82	3.9	3/82	9.4	3/82	9.4	3/82				
B C	110	4/87	110	4/87	22	4/87	22	4/87			1 450					
D			- 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	<del>.</del>									<del></del>			
E				<del> </del>					.8.							
F	<u> </u>		73 J								+ 5.5					
G G	<u> </u>		127					<del>-</del> .			<del></del>		<del>                                     </del>		·····	
Ħ			7.7.													
NO.1											. 4.					
NO.2			1,11,20									· · · · · · · · · · · · · · · · · · ·				
NO.3			<u> </u>		1.4.						2.7					
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NO:10		<u> </u>			4,40,4						- : '- :					
NO.11	12	3/82	12	3/82	5.3	3/82	5.3	3/82	1100	<b>6</b>	****	4.05		<u> </u>		
NO.12	925	3/82	925	3/82	330	3/82	330	3/82	1190	3/82	1190	3/82	38	3/82	38	3/82
NO.13 NO.16	ele two			· · · · · · ·	e galac alegger											
NO.18	Part des				1 2 2		<del></del>	<del></del>			<u> </u>	· · · · · · · · · · · · · · · · · · ·				
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WCC-IM	32	4/87	32	4/87	41.64		****				<u>- 7, 199</u> 1,474					
WCC-ID	- 32						, .				<u>, 5 - 5</u> % 3					
WCC-2							- A									
WCC-2M			. 6 4 7 , 34 1		\$ 4.5			,			1.6.		-			
WCC-3M	V seed		******		न्यं कृ		2022				: .					<del></del>
WCC-3D	(1.37%)		+8,18													
WCC-4S	10404						64.35°		- 17.77							
WCC4M	1		11.		13. (T.)		- 21 .							•	7.607	
WCC-5S	81		81		1.75		1.14.									
WCC-65	26.3	3/82	185			3/82	82		116	3/82	185	3/82	56	3/82	2200	3/82
WCC-6M	4.9	3/82	4.9	3/82	and the second				197 m.		:					
WCC-6D	2.1		3.15	3/90	. S. A		5.4		7.0		7.0	2/00				
WCC-7M WCC-9S	3.1	3/82	3.1	3/82	3.4	3/82	5.4		1.2	3/82		3/82	<del>-   :</del> -			
WCC-9S					VA 1 4 50				A Property Control							
WCC-9D	nejs Nejski				78. <u>8.37</u> 4 1								2.7	3/82	2.7	3/82
WCC-IIS	24			3/82	6.4	3/82	. 16	4/87	6.8	3/82		3/82	2.1	5,02	<u> </u>	
WCC-IIMN	23		23		6			3/82	9.3			3/82				
WCC-IIDC	2.5	3/82	2.5	3/82					1		7.3		<del>-  </del>	·		
WCC-12M	1600	4/87	1600	4/87		11/88	50	11/88								
WCC-13																
WCC-14S														·		
WCC-15SE	131	3/82	131	3/82	14.1	3/82	68	4/87	42	3/82	42	3/82				
WCC-ISM			· .													
WCC-15D	41	3/82	-41	3/82	12.4	3/82	12.4	3/82	30	3/82	30	3/82				
WCC-163															·	
L-1A																
L-2																
L-3							A-2	259								
L4							_									

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	Trans-1,2-dichloroethylene	Ethylbenzene	Total xylenes	1,1,1-trichloroethane				
Wells	Low Date High Date	Low Date High Date	Low Date High Date	Low Date High Date				
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Wells	Low Date High D		ligh Date	Low Date High Date	Low Date High Date
M-1	sec William Communication	24 3/82	24 3/82		
M-2		/82			
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WCC-IIS			<u> </u>		
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WCC-13 WCC-14S	·	<u> </u>			
WCC-14S WCC-15SE				········	
WCC-ISM		87			
WCC-15D					
WCC-16S					
L-1A					
L-2		A-261			
L-3		<u> </u>			
L4					

	Trichlore	oethyler	ne		Crysen	е			1,3-di	chlorol	penzene	1,4-dic	hlorol	enzen	e
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High Date	Low	Date	High	Date
L-5														<u>~_</u>	
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DEP-2							<del></del>		<del></del>			1.			
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DW-25															
DW-3D						_		<del></del>	<del></del>			-	•		
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PA-05	<u> </u>				1 17							1		**. *	
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	Hexachlorobenzene	Hexachlorobutadiene	n-Nitrodiphenylamine	Benzidene	Dimethylphthalate
Wells	Low Date High Date	Low Date High Date	Low Date High Date	Low Date High Date	Low Date High Date
M-1			<b>.</b>		Date Ingli Date
M-2	2				
M-3					<u> </u>
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Wells	Low	Date	High		Low	Date	High Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
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DEP-4	3				% g ^{a‡} .		1,4640	L 1.5		11.		1				1			
DW-IS			July 15																
DW-ID					31											-			_
DW-2S			1911		11. 124	:						a per		1 271		1			
DW-3S							186 J.			٠.		1.				1		-	
DW-3D																			
DW-48			5 .				12.11												
DW4D			1,55		1.5									N 1					
DW-5S																1			
DW-5D														3					
DW-68														15 %				:	
DW-6D	÷,.							1		1.15				Jan 80		1 1			
DW-7S			2 .				1.					]				11.	1/88	11	1/88
DW-7D							<u> </u>					.e 1 : :		1					
SAY-PRO A	: .						J.									1.00	-		
PA-05			12.5											100				1.50	
										st _{all}									
FB-1	: • •		, 18 h				<u></u>							1		14.3		100	
FB-2					12.4							1		y	-				
FB-3	16	4/87	16	4/87	1. 1.47		ier e	V .		11 1 1		1.57		. Vita ita		Alega,			
FB-4							·.							Ž. 7			<u> </u>	33.7	
TB-1	31	4/87	31	4/87	s 2.2 .			- Ear ,				14		n, Çer		1.1111		1150 (1250 (1250)	
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TB-3	. 6	4/87	6	4/87								1		9 :					
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	Chlorom	nethane	Trichlore	ofluoro	methan	e	1,2-dic (total)	hioroet	hane		Tetrachl	oroethen	e
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8-3			<del> </del>				<del> </del>				<del>                                     </del>		
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D											<u> </u>		
Б	39												
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8	4.717.		<del>                                     </del>						· · ·	<del> </del>	1	·	
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WCC-12M							400	11/88		11/88			
WCC-13													
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WCC-15M	9	4/87 9 4/87	<del>                                     </del>				1						
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L-1A		•	•										
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	Chloro	methar	ne		Trichl	orofluo	rometha	ne	1,2-die (total)	chloroe	hane		Tetrac	hloroetl	nene	
Wells		Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
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T-1			iji tikaj		1.5								un Mil			
DEP-I	i, iii		$f_{i_1,i_2,\ldots,i_{k+1}}$				Mary Hill				. 10					
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DEP-4			e design													
DW-IS																
DW-1D			upriga ,						10	11/88	10	11/88			-	
DW-25					45											
DW-3S							4									
DW-3D													1.1			
DW-48			11.11						23		en e					
DW4D							i de la				1.5		1.74			
DW-5S											5-6-1 20					
DW-5D									34	11/88	34	11/88	18	11/88	18	11/88
DW-68								-	1		18 11 1					
DW-6D									<u> </u>		y th				4.50	
DW-7S			1 1		·		:		56	11/88	56	11/88	24	11/88	. 24	11/88
DW-7D					<u> </u>		···									
SAY-PRO A			34													
PA-05	141		Öüleki		3	4/87	3	4/87	7							
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FB-1	In the same										19: A	·	H.A.		1 km/ 1	,
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FB-4													7.48			
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TB-4	11.0		(a.)				1,1,20								1	
MB					2	4/87	2	4/87							fa	

	Trichlo	roethen	e		1,3-dich	loropro	pene	
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M-1					1		<del>-:</del>	
M-2			***					
M-3								
M-4								
M-5			- N					
M-6								
S-I							133	
S-2							1	
S-3								
A								
B	48	5/85	48	5/85	6	5/85	6	5/85
C							· · ·	
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G .	. ` -				1		2.1	
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NO.10					$\bot$			
NO.11								
NO.12	120	5/85	120	5/85			<u> </u>	
NO.13					- No.		1,221	
NO.16			.1 . 1				<u> </u>	
NO.18								
NO.19			4.			· 		
WCC-IM			<u> </u>				3, 4	
WCC-ID								
WCG-2	<u> </u>							
WCC-2M					1 1 1 mg			
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WCC-3D			<del></del>		371 2. 91.59%			
WCC-4S							<u> </u>	
WCC-4M	3 (40 ha) 1.		20192		LÁTAIR Land			<del></del>
WCC-5S	1.4. <u></u>		- 19		-12/11/23/25 -12/11/25/2		griphi) Liber	
WCC-65				<u> </u>				
WCC-6M WCC-6D			W		ysity n Cytakk	<u> </u>		
WCC-7M					No trains		7 A	
WCC-9S					110017	-		
WCC-9M					12.74			
WCC-9D				-			v	
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WCC-12M					<del>                                     </del>	·	119.	<del></del>
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WCC-14S	8		<u>-</u>		1		<del></del>	
WCC-15SE	340	5/85	340	5/85				
WCC-155E	1	2,33	340		-			
WCC-15D	+				-			
WCC-168	<del>                                     </del>		· · ·		_			-
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	Trichl	oroethene	_	1,3-dichlore	propene
Wells	Low	Date High	Date	Low Da	te High Date
L-5					7
T-1	33	5/85 . 33	5/85	1 1 1 1 1	
DEP	4 1	***		a. No. 1	
DEP-2				1 455	
DEP4	1 1	2.71		2. I S	
DW-1S	2000	n Hallen			
DW-ID				20, 27,	
DW-25				1.2	·
DW-3S				1.5	
DW-3D					
DW-48	. :	Agricultural Control	···	· · · VI	
DW4D		1.10			
DW-SS					
DW-5D		188 324		12 3 12	
DW-6S					
DW-6D					
DW-7S		2.74			
DW-7D					
SAY-PRO A					
PA-05				1.	
FB-1		1000			
FB-2	1 4.				
B-3	: .	115,55		extract.	
B-4					<del>-</del>
B-1					
B-2	Lenn.			La tradició	en de la
B-3					
B-4	Sala,			a typ	g + 35
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# APPENDIX A-8 COMPLETE ANALYTICAL RESULTS OF 1990 SAMPLES

APPENDIX A-8. COMPLETE ANALYTICAL RESULTS OF 1990 SAMPLES

Parameter Collection Date	Units	Method Detection Limit	CPS-DW-5D 3/21/90	CPS-DW-5S 3/21/90	CPS-WCC-5S 3/21/90	CPS-WCC-6M 3/21/90	CPS-WCC-6S 3/21/90	CPS-DW-7D 3/21/90	CPS-DW-7S 3/21/90	CPS-DW-8D 3/21/90	CPS-DW-8S 3/21/90	CPS-WCC-11M 3/21/90	CPS-DW-12 3/21/90
VOLATILE ORGANIC COMPOUNDS													
Chloromethane	μg/L	10	10	10	10	10	. 10	10	10	10	10	10	10
Bromomethane	μg/L	10	10	10	10	10	10	10	10	10	10	10	10
Vinyl Chloride	μg/L	10	10	10	10	10	10	10	10	10	10	10	10
Chloroethane	μg/L	10	10	10	10	10	10	10	10	10	10	10	10
Methylene Chloride	μg/L	5	5	5	5	5	5	5	5	5	5	5	. 5
Trichlorofluoromethane	μg/L	10	10	10	10	10	10	10	- 10	10	10	10	10
Acrolein	μg/L	100	100	100	100	100	100	100	100	100	100	100	100
Acrylonitrile	μg/L	35	• 35	35	35	35	35	35	35	35	35	35	35
1,1-Dichloroethene	μg/L	5	• 5	5	5	5	5	5	5	5	5	5	5
1,1-Dichloroethane	μg/L	5	5.	5	5	5	5	5	5	5	5	5	5
1,2-Dichloroethene (total)	μg/L	5	5	5	5	4	5	5	5	5	5	5	5
Chloroform	μg/L	5	5	5	5	5	5	5	5	5	5	5	5
1,2-Dichloroethane	μg/L	5	5	5	5	5	5	3	5	5	5	5	5
1,1,1-Trichloroethane	μg/L	5	5	· 5	5	5	5	5	5	5	5	• 5	5
Carbon Tetrachloride	μg/L	5	5	5	5	5	5	5.	5	. 5	5	5	5
Bromodichloromethane	μg/L	5	5	. 5	. 5	5	5	5	5	5	5	5	5
2-Chloroethylvinylether	μg/L	10	10	10	` 10	. 10	10	10	10	10	10	10	10
1,2-Dichloropropane	μg/L	5	5	5	5	5	5	5	5	5	5	5	5
cis-1,3-Dichloropropene	μg/L	5	5	5	5	5	5	5	5	5	5	5	5
Trichloroethene	μg/L	5	5	5	5	6	5	5	5	5	5	. 5	5
Benzene	μg/L	5	5	· 3	5	5	5	5	5	5	5	5	5
trans-1,3-Dichloropropene	μg/L	5	. 5	5	5	5	. 5	5	5	5	5	5	5
Dibromochloromethane	μg/L	5	5	. 5	. 5	5	5	5	5	5	5	5	5
1,1,2-Trichloroethane	μg/L	5	5	5	5	5	5	5	5	5	5	5	5
Bromoform	μg/L	5	5	5	5	5	5	5	5	5	5	5	5
Tetrachloroethene	μg/L	5	5	5	5	. 5	5	5	5	5	5	5	5
1,1,2,2-Tetrachloroethane	μg/L	5	5	5	5	5	5	. 5	5	5	5	5	5
Toluene	μg/L	5	5.	5	5	5	5	5	5	5	5	5	5
Chlorobenzene :	μg/L	5	5	13	5	5	5	35	5	5	5	5	5
Ethylbenzene	μg/L	5	5	5	5	5	5	7	. 5	5	- 5	5	5
METALS .	•										_		
Cadmium	μg/L	10	10	10	10	21.2	10	10	10	10	10	29.8	
Copper	μg/L	25	36.5	25	128	494	25	25	25	36	25	25.7	47.9
Lead	μg/L	3	7.8	3	24.6	100	51	3	3	11.1	5.5	3	13.4
Zinc	μg/L	20	415	26600	1220	3830	320	106	120	7760	1350	26400	4180

APPENDIX A-8. COMPLETE ANALYTICAL RESULTS OF 1990 SAMPLES

		Method											
Parameter Collection Date	Units	Detection Limit	CPS-WCC-1M	CPS-MI-02	CPS-MW-3D	CPS-MW-3S	CPS-MW-4S	CPS-MW-4D	CPS-FB-01	CPS-TB-01 3/20/90	CPS-DW-1S 3/21/90	CPS-DW-1D 3/21/90	CPS-DEP-3/21/90
Collection Date	·		3/20/90	3/20/90	3/20/90	3/20/90	3/20/90	3/20/90	3/20/90	3/20/90	3/21/90	3/21/90	3/21/90
VOLATILE ORGANIC COMPOUNDS												,	,
Chloromethane	μg/L	10	10	10	10	10	10	10	10	10	10	10	1
Bromomethane	μg/L	10	10	10	10	10	10	10	10	10	10	10	11
Vinyl Chloride	μg/L	10	10	10	10	10	10	10	10	10	10	10	1
Chloroethane	μg/L	10	10	10	10	10	10	10	10	10	10	10	1
Methylene Chloride	μg/L	5	5	5	5	5	. 5	. 5		5	. 5	71	_
Trichlorofluoromethane	μg/L	10	10	10	10	10	10	10	10	10	10	10	. 1
Acrolein	μg/L	100	100	100	100	100	100	100	100	100	100	100	10
Acrylonitrile	μg/L	35	35	35	35	35	35	35	35	35	35	35	3
1,1-Dichloroethene	μg/L	5	5	5	5	5	5	5	5	5	5	5	
1,1-Dichloroethane	μg/L	5	5	5	5	5	5	5	5	5	5	5	
1,2-Dichloroethene (total)	μg/L	5	8	5	5	5	5	5	5	5	5	5	
Chloroform	μg/L	5	5	5	5	5	5	5	5	5	5	5	
1,2-Dichloroethane	μg/L	5	20	5	5	5	5	5	5	5	5	14	
1,1,1-Trichloroethane	μg/L	5	5	5	5	5	5	5	5	5	5	5	
Carbon Tetrachloride	μg/L	5	5	5	5	5	5	5	5	5	5	5	
Bromodichloromethane	μg/L	5	5	- 5	5	5	. 5	5	5	5	5	5	!
2-Chloroethylvinylether	μg/L	10	10	10	10	10	10	10	10	10	10	10	1
1.2-Dichloropropane	μg/L	5	5	5	5	5	5	5	5	5	5	5	
cis-1,3-Dichloropropene	μg/L	5	5	5	5	5	5	5	5	5	5	5	
Trichloroethene	μg/L	5	11	5	5	5.	5	5	5	5	5	5	
Benzene	μg/L	5	5	5	5	5	5	5	5	5	63	6	6
trans-1,3-Dichloropropene	μg/L	5	5	5	5	5	5	5	5	5	5	5	
Dibromochloromethane	μg/L	5	5	5	5	5	5	5	5	5	5	5	
1,1,2-Trichloroethane	μg/L	5	5	5	5	5	5	5	5	5	5	5	
Bromoform	μg/L	5	5	5	5	5	5	5	5	5	5	5	
Tetrachloroethene	μg/L	5	. 5	5	5	5	5	5	5	5	5	5	
1,1,2,2-Tetrachloroethane	μg/L	5	5	5	5	5	5	5	5	-5	5	5	
Toluene	μg/L	5	5	5	5	. 5	5	5	5	5	5	8	
Chlorobenzene	μg/L	5	5	5	5	5	5	5	5	5	340	47	. 9
Ethylbenzene	μg/L	5	5	5	5	5	5	5	5	5	10	5	1
METALS								•					
Cadmium	μg/L	10	10	11300	10	10	10	10	10	NA	10	10	1:
Copper	μg/L	25	25	9800	25	25	25	25	33	NA	. 25	66.9	2
Lead	μg/L	3	6.5	1668	3	3	3	3	3	NA	3	15.3	
Zinc	μg/L	20	638	1900000	752	562	403	530	393	NA	470	391	30.

APPENDIX A-8. COMPLETE ANALYTICAL RESULTS OF 1990 SAMPLES

													· · · · · · · · · · · · · · · · · · ·
Parameter	allastian Bata	Units	Method Detection Limit	CPS-WCC-12	CPS-WCC-13	CPS-WCC-15M 3/21/90	CPS-WCC-16VS 3/21/90	CPS-FB-02 3/21/90	CPS-TB-02 3/21/90	CPS-MI-T1 3/22/90	CPS-DEP-4 3/22/90	CPS-MI-07 3/22/90	CPS-DW-9D 3/22/90
	ollection Date			3/21/90	3/21/90	3/21/90	3/21/90	3/21/90	3/21/90	3/22/90	3/22/90	3/22/90	3/22/90
	ANIC COMPOUNDS							•					•
Chloromethan	-	μg/L	10	10	10	10	10	10	10	10	10	10	10
<b>Bromomethane</b>		μg/L	10	10	10	10	10	10	10	10	10	10	10
Vinyl Chlorie		μg/L	10	19	10	10	10	10	10	10	10	10	10
Chloroethane		μg/L	10	10	10	10	10	10	10	10	10	10	10
Methylene Ch	loride	μg/L	5	5	5	5	5	5	5	5	5	5	5
Trichloroflu	oromethane	μg/L	10	10	10	10	10	10	10	10	10	10	10
Acrolein		μg/L	100	100	100	100	100	100	100	100	100	100	100
Acrylonitril	e	μg/L	35	35	35	35	35	35	35	35	35	35	35
1,1-Dichloro	ethene	μg/L	5	5	、 5	5	5	5	5	5	5	5	5
1,1-Dichloro		μg/L	5	5	5	5	5	5	5	5	5	. 5	5
1,2-Dichloro	ethene (total)	μg/L	5	91	5	5	· 5	5	5	5	5	5	5
Chloroform	•	μg/L	5	5	5	5	5	5	5	5	5	5	5
1,2-Dichloro	ethane	μg/L	5	11	. 5	9	5	. 5	5	57	5	5	5
1,1,1-Trichle	oroethane	μg/L	5	5	5	5	5	5	5	5	5	5	5
Carbon Tetra	chloride	μg/L	5	5	5	5	5	5	5	5	5	5	5
Bromodichlore	omethane	μg/L	5	5	5	5	5	5	5	5	5	5	5
2-Chloroethy	lvinylether	μg/L	10	10	10	10	10	10	10	10	10	10	10
1.2-Dichloro	propane	μg/L	5	5	5	5	5	5	5	5	5	5	5
cis-1,3-Dich	loropropene	μg/L	5	5	5	5	5	5	5	5	5	5	5
Trichloroeth	ene	μg/L	5	5	5	5	. 5	5	5	8	5	5	5
Benzene	•	μg/L	5	40	5	5	91	5	5	5	5	5	5
trans-1.3-Die	chloropropene	μg/L	5	5	5	5	- 5	5	5	5	5	5	5
Dibromochlore		μg/L	5	5	5	5	5	5	5	5	5	5	5
1,1,2-Trichle		μg/L	5	5	5	5	5	5	5	5	5	5	5
Bromoform		μg/L	5	5	5	5	5	5	5	5	5	5	5
Tetrachloroe	thene	μg/L	5	5	5	5	5	5	5	5	5	5	5
	ach loroethane	μg/L	5	. 5	5	6	5	5	5	5	5	5	5
Toluene		μg/L	5	97	5	5	8	5	5	5	5	5	5
Chlorobenzene	•	μg/L	5	790	5	5	560	5	5	5	5	5	5
Ethylbenzene	_	μg/L	5	16.	5	5	27	5	5	5	5	5	5
METALS													
Cadmium		μg/L	10	10	10	10	10	10		207	10	10	10
Copper		μg/L	25	25	25	89.4	25	25	. NA	217	25	25	25
Lead		μg/L	3	6.6	6.4	15.3	3	3	NA	39.2	3	3	3
Zinc		μg/L	20	42.5	190	5800	346	20	NA	9510	2330	7840	154

APPENDIX A-8. COMPLETE ANALYTICAL RESULTS OF 1990 SAMPLES

		Method Detection			CPS-DW-13D 3/22/90				CPS-TB-03 3/22/90	PA-A-014
Parameter Collection Date	Units	Limit	CPS-DW-9S 3/22/90	CPS-DW-10D 3/22/90		CPS-DW-13S 3/22/90	CPS-DW-14 3/22/90	CPS-FB-03 3/22/90		
VOLATILE ORGANIC COMPOUNDS										
Chloromethane	μg/L	10	10	10	10	10	10	10	10	10
Bromomethane	μg/L	10	10	10	10	10	10	10	10	10
Vinyl Chloride	μg/L	10	10	10	10	10	10	10	10	10
Chloroethane	μg/L	10	10	10	10	10	10	10	10	10
Methylene Chloride	μg/L	5	5	5	5	5	· 5	92	5	5
Trichlorofluoromethane	μg/L	10	10	10	10	10	10	10	10	10
Acrolein	μg/L	100	100	100	100	100	100	100	100	100
Acrylonitrile	μg/L	35	35	35	35	35	35	35	<u>3</u> 5	35
1,1-Dichloroethene	μg/L	5	5	5	5	5	. 5	5	5	5
1,1-Dichloroethane	μg/L	5	5	5	5	5	5	5	5	5
1.2-Dichloroethene (total)	μg/L	5	5	5	5	5	5	5	5	5
Chloroform	μg/L	5	5	5	5	5	5	5	5	5
1.2-Dichloroethane	μg/L	5	5	5	5	5	5	5	5	200
1,1,1-Trichloroethane	μg/L	5	5	5	5	5	5	5	5	5
Carbon Tetrachloride	μg/L	5	5	5	5	5	5	5	5	5
Bromodichloromethane	μg/L	5	5	5	5	5	5	5	5	5
2-Chloroethylvinylether	μg/L	10	10	10	. 10	10	10	10	10	10
1,2-Dichloropropane	μg/L	5	5	5	5	5	5	5	5	5
cis-1,3-Dichloropropene	μg/L	5	5		5	5	5	5	5	5
Trichloroethene	μg/L	5	5	5	5	5	5	5	5	24
Benzene	μg/L	5	. 5	69	24	28	11	5	5	5
trans-1,3-Dichloropropene	μg/L	5	5	5	-5	5	5	5	5	5
Dibromochloromethane	μg/L	5	5	5	5	5	5	5	5	5
1,1,2-Trichloroethane	μg/L	5	5	. 5	5	5	5	5	5	5
Bromoform	μg/L	5	5	5	5	5	5	5	5	5
Tetrachloroethene	μg/L	5	5		. 5	5	5	5	5	5
1,1,2,2-Tetrachloroethane	μg/L	5	5	5	5	5	5	5	5	5
Toluene	μg/L	5	5	5	5	5	. 5	5	5	5
Chlorobenzene	μg/L μg/L	5	Š	590	22	48	, 5	5	5	5
Ethylbenzene	μg/L μg/L	ś	5	17	5	- 5	5	5	5	Ś
Litty (Defizerie	µg/ L	,	,	"	,	,	,		,	•
METALS				<u></u>						
Cadmium	μg/L	10	. 10		10	10	10	10	NA	10
Copper	μg/L	25	48.7	25	25	25	25	25	NA	25
Lead	μg/L	3	12.9	3	3	3	3	3	NA	4.1
Zinc	μg/L	20	3750	54.5	184	176	6.16	27.8	NA	5720

# APPENDIX A-9 PUBLIC HEALTH RISK EVALUATION PROCESS

## APPENDIX A-9. PUBLIC HEALTH RISK EVALUATION PROCESS

#### INTRODUCTION

Risk Assessment is an essential component of the Remedial Investigation Feasibility Study (RI/FS) process at hazardous waste sites. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP: the regulation that implements CERCLA), require that actions selected to remedy hazardous waste sites be protective of human health and the environment. An overview of risk assessment in the RI/FS process is presented in the NCP and in the EPA manual <u>Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA</u> (USEPA 1988b). A baseline risk assessment is conducted as part of the RI to assess site conditions in the absence of remedial actions. As part of the FS process, risk assessment is used to evaluated the acceptability of proposed remedial actions and as a tool in the development of remediation objectives (target cleanup levels).

A preliminary baseline public health risk assessment has been conducted for waste sites under evaluation at the CPS/Madison waste site. The public health risk assessment at CPS/Madison examines the presence and release of chemicals from the sites under investigation, the observed levels of the compounds in the environment, the potential routes of exposure to human receptors, and the likelihood of adverse health effects following contact with contaminated environmental media. A detailed overview of the assessment methods used is presented in the following discussion. The focus of this evaluation is not an absolute assessment of the risks of exposure to the chemicals present at the sites under investigation. Rather, this evaluation is an assessment of the relative magnitude of anticipated health problems that may be associated with exposure to chemicals detected at the site. The intention is to determine if there is a significant threat to human health and to assess the need for further site remediation.

## OVERVIEW OF METHODS

The general approach to public health risk evaluation of exposure to chemical contaminants has been well-established. The National Research Council (NRC) prepared a comprehensive overview of the structure of this assessment (NRC 1983) that has become the foundation for subsequent EPA guidance. The <u>Human Health Evaluation Manual</u> and the <u>Environmental Evaluation Manual</u> (USEPA 1989a,b) provide a detailed presentation of the risk assessment process. These documents are the Agency's key guidance on risk assessment under the Superfund Program. As specified by EPA, the public health evaluation process may be divided into four fundamental component analyses: (1) data evaluation and hazard identification, (2) exposure assessment, (3) toxicity or hazard assessment, and (4) risk characterization. These analyses are briefly described in the following sections.

## Data Evaluation and Hazard Identification

The first step in the risk assessment process is to obtain and evaluate all available data on contaminants present at the sites under investigation. The objective is to organize the data into a form appropriate for the baseline risk assessment. Once the preliminary data set has been obtained and sorted by environmental medium, the following evaluation steps should be completed:

- o Evaluate the analytical methods used to determine if results are appropriate for use in quantitative risk assessment.
- o Evaluate the quality of data with respect to sample quantitation and detection limits.
- o Examine laboratory qualifiers assigned to monitoring data and evaluate potential QA/QC problems.
- o Evaluate the quality of data with respect to blanks, and tentatively identified compounds (TICs).
- o Summarize information on background concentrations of chemicals and compare with observed levels of site-related contamination.
- o Identify chemicals of potential concern: develop a data set that may be appropriately used in the risk assessment process.
- o If appropriate, further limit the number of chemicals to be used as the subject of the risk assessment.

From the full listing of all chemicals identified at a waste site or facility, a subset may be identified that is of sufficient quality to be used in risk assessment. Representative "highest risk" compounds may be selected on the basis of: (1) quantities present at the site; (2) extent of environmental contamination, toxicity, or hazardousness; and (3) mobility and persistence of the chemical in the environment. This final step is specified as optional by EPA, and does not improve the quality or accuracy of the risk assessment. It is suggested as a device for facilitating the risk assessment process when time and resources prohibit the evaluation of the full (and often complex) data set (USEPA 1989a).

### Exposure Assessment

General Approach and Receptors at Risk

The objectives of the exposure assessment are to: (1) delineate exposure pathways; (2) identify receptors at risk; and (3) measure or estimate for each receptor the intensity, duration, and frequency of the exposure. Critical to the exposure assessment is a quantification of the releases of contaminants of concern to each environmental medium (from all sources at the waste site) and an assessment of the transport and transformation of the subject compounds. The results of these analyses provide data on the magnitude and extent of contamination. Both monitoring data and environmental transport modeling typically are used in the exposure assessment.

EPA has specified that actions at hazardous waste sites should be based on an estimate of the <u>reasonable maximum exposure (RME)</u> expected to occur under both current and future land-use conditions (USEPA 1989a). EPA defines the reasonable maximum exposure as the highest exposure that is reasonably expected to occur at a site. RMEs are estimated for individual pathways, and combined across across exposure routes if appropriate.

Once receptors at risk are identified, environmental concentrations at points of exposure must be determined or projected. In the evaluation of CPS/Madison, exposure concentrations are based completely on the results of site monitoring. No transport modeling has been used. Representative concentrations for use in risk assessment are taken as the arithmetic mean of the sampling results. "Not detected" results were treated as one half the limit of detection and included in calculation of the arithmetic mean.

Dose estimates (in mg/kg/day) are developed for each chemical of concern using the representative environmental concentrations (i.e., mean values). Estimates of dose are needed in the risk characterization and are generally determined as follows:

Dose = C x 
$$\frac{CR \times EFD \times ABS}{BW \times AT}$$

Where

C = Chemical concentration in the environmental medium under evaluation.

EFD = Exposure frequency and duration; how long and often exposure occurs.

ABS = Absorption factor

BW = Body weight; the average over the exposure period.

and,

AT = Averaging time; the period over which exposure is averaged.

The equation above is used to derive estimates of subchronic or chronic dose (lifetime assumed to be 75 years). The chronic dose estimate based on mean

concentrations in environmental samples (arithmetic mean) was used as the basis of the risk characterization at all sites under investigation.

Comparison with Applicable or Relevant and Appropriate Requirements

Once the baseline concentrations of subject chemicals have been determined at the waste sites, these levels are compared to applicable or relevant and appropriate requirements (ARARs). CERCLA of 1980 as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 requires the selection of remedial actions at Superfund hazardous waste sites that are protective of human health and the environment, cost-effective, and technologically and administratively feasible. Section 121 of CERCLA specifies that response action must be undertaken in compliance with ARARs established in Federal and state environmental laws.

In the revised National Contingency Plan (NCP: 55 FR 8666) and the guidance document CERCLA Compliance with Other Laws Manual (USEPA 1988, 1989d), several different types of requirements are identified with which Superfund remedial actions must comply: (1) ambient or chemical-specific requirements, (2) action-specific requirements, and (3) location-specific requirements. Because situations at CERCLA sites vary widely, EPA cannot categorically specify requirements that will be ARARs for every NPL site. ARARs can only be identified on a site-specific basis (i.e., established in connection with the characteristics of the particular site, the chemicals present at the site, and the remedial alternatives suggested by the circumstances of the site).

In the RI/FS process, the evaluation of remedial alternatives must consider effectiveness, implementability, and cost. Within the context of the effectiveness evaluation, chemical-specific ARARs assume major significance. Each alternative is evaluated with regard to effectiveness in protecting human health and the environment. Effectiveness criteria include protectiveness and the envisioned reduction of toxicity, mobility, or volume through treatment.

According to the guidance presented in the revised NCP, protectiveness (i.e., the ability to protect human health and the environment) means that a given remedial alternative meets or exceeds ARARs, or other risk-based levels established through a risk assessment when ARARs do not exist or are waived. (Note that compliance with chemical-specific is not required for interim remedies. 55 FR 8666). In the NCP and in the guidance manual on CERCLA compliance with other laws (55 FR 8666, USEPA 1988a, 1989d), EPA specifies that when ARARs are not available for a given chemical, or where such ARARs are not sufficient to be protective, health advisory levels should be identified or developed in order to ensure that a remedy is protective.

For carcinogenic effects, these health advisory or cleanup levels are to be selected such that the total risk of all contaminants falls within the acceptable range of  $10^{-4}$  to  $10^{-6}$ . Although the  $10^{-6}$  risk level is identified by EPA as a "point of departure" in evaluating the results of risk assessment, the revised NCP clearly indicates that the  $10^{-4}$  level is the upper bound of the acceptable range (55 FR 8666). In cases where noncarcinogenic effects are a concern, EPA specifies that cleanup should be

based on acceptable levels of exposure as determined by the EPA reference doses (RfDs), taking into account the effects of multiple contaminants and multiple exposure pathways at the site.

Therefore, chemical-specific ARARs serve two primary purposes: (1) requirements that must be met by a selected remedial alternative (unless a waiver is obtained), and (2) as a basis for establishing appropriate cleanup levels. The public health risk assessment of a given remedial action alternative characterizes the actual risk of exposure of human receptors to contaminants under investigation. For carcinogens, risk characterization yields a probabilistic estimate of the additional lifetime risk of cancer in the exposed individual or the incidence of new cases of cancer in populations. For noncarcinogens, exposure levels or doses for all subject compounds are evaluated to determine levels or doses if these exceed EPA RfDs. ARAR is available for all subject compounds of concern, and the ARARs are determined to be protective, these requirements become the chemical-specific cleanup goals. However, as noted above, when ARARs are found not to be protective or are not available, the results of the risk assessment (i.e., health advisory levels) are used to establish the more stringent target cleanup goals.

Thus, the requirement that a remedial alternative meet chemical-specific ARARs does not ensure that the proposed alternative is protective, and thereby potentially acceptable. This can be determined only by: (1) evaluating the combined carcinogenic risk associated with the ARAR limits for all chemicals at a given site (assuming additivity of effect in the absence of data on synergism or antagonism); (2) establishing that ARARs do not exceed USEPA RfDs for noncarcinogenic effects, and are sufficiently protective when multiple chemicals are present; (3) determining whether environmental effects (in addition to human health considerations) are adequately addressed by the ARARs; and (4) evaluating whether the ARARs adequately cover all significant pathways of human exposure identified in the baseline risk assessment. EPA has provided guidance on evaluating multiple exposure to chemicals (carcinogenic and noncarcinogenic effects) and on establishing acceptable exposure levels when no ARARs exist (USEPA 1986c, 1989a).

#### Toxicity Assessment

The objectives of the toxicity or hazard assessment are to evaluate the inherent toxicity of the compounds under investigation, and to identify and select toxicological measures for use in evaluating the significance of the exposure. In the development of these toxicological measures, available dose-response data are reviewed on the adverse effects to human and nonhuman receptors. Dose-response assessments for noncarcinogens provide an estimate of the no-observable-adverse-effect level (NOAEL) or lowest-observable-adverse-effect level (LOAEL). For carcinogenic compounds, the dose-response assessment yields estimates of probability or range of probabilities under which a carcinogenic effect will occur at a specified level of exposure.

In conducting an assessment of risk of exposure to chemicals released from waste sites, several toxicity measures of importance may be identified:

- o RfDs for oral exposure acceptable intake values for subchronic and chronic exposure (noncarcinogenic effects)
- o RfDs for inhalation exposure acceptable intake values for subchronic and chronic exposure (noncarcinogenic effects)
- o Carcinogenic potency factors for oral exposure
- o Carcinogenic potency factors for inhalation exposure.

The RfDs and potency factors for oral exposure are the toxicity measures needed in the assessment for CPS/Madison. Long-term (i.e., chronic) exposure and health risk is the focus of the evaluation at all sites.

The primary sources of information for these data is the Integrated Risk Information System (IRIS) data base. IRIS is a computer-housed catalog of EPA risk assessment and risk management information for chemical substances. Data in the IRIS system is regularly reviewed and updated monthly. If toxicity measures are not available on IRIS, EPA recommends use of the EPA ORD Health Effects Assessment Summary Tables (HEAST: FY 1989. USEPA 1989c) as the second most current source of information. SAIC has on-line access to the IRIS Data Base and receives the quarterly HEAST publications from EPA ORD. Therefore, the risk assessment is based on the most up-to-date EPA-approved toxicity measures available for waste site evaluation.

A summary of the toxicity measures used in the evaluation of the waste sites at CPS/Madison is presented in Table A-1. Toxicity measures for chronic oral and inhalation exposure are used in the baseline risk assessmet. The table provides a comprehensive list of RfDs (chronic and subchronic when available), carcinogenic potency factors (oral and inhalation routes), weight of evidence ratings, and sources of information.

## Risk Characterization

The last step in the baseline public health evaluation is risk characterization. This is the process of integrating the results of the exposure and hazard (toxicity) assessment (i.e., of comparing estimates of dose with appropriate toxicological endpoints to determine the likelihood of adverse effects in exposed populations). It is common practice to consider risk characterization separately for carcinogenic and noncarcinogenic effects. This is due to a fundamental difference in the way organisms typically respond following exposure to carcinogenic or noncarcinogenic agents. For noncarcinogenic effects, toxicologists recognize the existence of a threshold of exposure below which there is only a very small likelihood of adverse health impacts in an exposed individual. Exposure to carcinogenic compounds, however, is not thought to be characterized by the existence of a threshold. Rather, all levels of exposure are considered to carry a risk of adverse effect.

The procedure for calculating risk associated with exposure to carcinogenic compounds has been established by EPA (USEPA 1986b,c; USEPA 1989a). A non-threshold, dose-response model is used to calculate a carcinogenic potency

TABLE A-1. TOXICITY MEASURES FOR WASTE SITE EVALUATION: INGESTION AND INHALATION PATHWAYS

COMPOUND	Noncarcinogenic Effects Oral Route (mg/kg/day) RfD-S (a) RfD-C (b)		Eff Inhalat Source (mg/k		nogenic cts on Route /day) RfD-C (b)	Source (Inhal.)	Effect of	Carcinogenic Potency Factor (q1*): Oral Exposure (mg/kg/day)-1	Source (Oral)	Carcinogenic Potency Factor (q1*): Inhalation Exposure (mg/kg/day)-1	Source (Inhal.)
INORGANICS											
Cadmium		5.00E-04	d		5.00E-04	d, j	Kidney			6.10E+00 [B1]	d
Copper	3.70E-02	3.70E-02	d,e		3.70E-02		GI Tract, Blood				
Lead		1.40E-03	d,m		1.40E-03	ď, j	CNS, Kidney				
Zinc	2.00E-01	2.00E-01	ď		2.00E-01	ď, j	GI Tract				
ORGANICS :								·			
Acrolein				1.00E-03	1.00E-04	d	Lung, Kidney			[C]	
Acrylonitrile							Lung, CNS	5.40E-01 [B1]	d	2.40E-01 [B1]	d
Benzene		3.60E-04	s				Hematopoietic Sys.	2.90E-01 [A]	d	2.90E-01 [A]	d
Bromodichloromethane		2.00E-02	Č				Liver, Kidney, CNS		ď		-
Bromoform	2.00E-01	2.00E-02	ď	2.00E-01	2.00E-02	ď, j	Liver, Kraney, one	7.90E-03 [B2]	ď		
Bromomethane	1.00E-02	1.00E-03	ď	6.00E-02	6.00E-02	ď	CNS	11702 05 [52]	_		
Carbon Tetrachloride	7.00E-03	7.00E-04	ď	7.00E-02	7.00E-04	ď, j	Liver	5.20E-02 [B2]	d	1.30E-01 [B2]	d
Chlorobenzene	2.00E-01	2.00E-02	d	5.00E-03	5.00E-03	ď	Liver, Kidney	J.20E-02 [B2]	u	1.300 01 [82]	<b>u</b>
			_					4 405-07 (02)	d	8.10E-02 [B2]	ď
Chloroform	1.00E-02	1.00E-02	d	1.00E-02	1.00E-02	d, j	Liver, Kidney, CNS		a	0.10E-02 [B2]	, а
Chloroethane	1.00E+00	1.00E-01	d,t	1.00E+00	1.00E-01	d, t	Liver, Kidney, CNS			4 705 07 501	_
Chloromethane							Liver, Kidney, CNS	1.30E-02 [C]	d	6.30E-03 [C]	ď
Dibromochloromethane	2.00E-01	2.00E-02	ď			_	Liver			, , , , , , , , , , , , , , , , , , , ,	
1,1-Dichloroethane	1.00E+00	1.00E-01	d	1.00E+00	1.00E-01	d	Liver, Kidney, CNS		ď	9.10E-02 [B2]	d <u>,</u> j
> 1,2-Dichloroethane	1.00E+00	1.00E-01	ď,h	1.00E+00	1.00E-01	ď,h	Liver, Kidney, CNS		d	9.10E-02 [B2]	d
່ງ 1,1-Dichloroethylene	9.00E-03	9.00E-03	d				Liver, Kidney, CNS		d ·	1.20E+00 [B2]	d
№ 1,2-Dichloroethylene	9.00E-03	9.00E-03	d, f	. • •	·		Liver, Kidney, CNS				
1,2-Dichloropropane	<b></b> ,						Liver, Kidney, CNS		d	[B2]	
1,3-Dichloropropene	3.00E-03	3.00E-04	d	1.00E-02	1.00E-02	d	Liver	1.80E-01 [B2]	ď		
Ethylbenzene	1.00E+00	1.00E-01	d				Skin, Liver, Kidne				
Methylene Chloride	6.00E-02	6.00E-02	ď	6.00E-02	6.00E-02	d, j	Liver, Kidney, CNS			4.70E-07 [B2]	ď
1,1,2,2-Tetrachloroethane					• •		Liver	2.00E-01 [C]	d	2.00E-01 [C]	d
Tetrachloroethylene	1.00E-01	1.00E-02	d	1.00E-01	1.00E-02	d, j	Liver, Kidney, CNS		ď	3.30E-03 [B2]	ď
Toluene	4.00E-01	3.00E-01	ď	2.00E+00	2.00E+00	ą,	CNS	21.02 02 [02]	_	2.302 03 ,52,	_
1,1,1-Trichloroethane	9.00E-01	9.00E-02	ď	3.00E+00	3.00E-01	ď	CNS, Lung, Kidney				
	4.00E-01	4.00E-02	ď	3.00E+00	3.00E-01	d,p	CNS, Lung, Kidney	5.70E-02 [C]	d	5.70E-02 [C]	d .
1,1,2-Trichloroethane			_		1.00E-02	α,ρ			ď	1.70E-02 [B2]	ď
Trichloroethylene	1.00E-01	1.00E-02	d, g	1.00E-01		c,k,j	Liver, Kidney, CNS	1.105-02 [82]	u	1.10E-02 [B2]	u
Trichlorofluoromethane	3.00E+01	3.00E+01	d,r				CNS	2 705.00 543	4	2 0Fr 04 543	_
Vinyl Chloride		1.30E-03	q				Blood, Liver, CNS	2.30E+00 [A]	d	2.95E-01 [A]	d

- a. RfD=Reference dose for subchronic (short-term) exposure.
- b. RfD=Reference dose for chronic (long-term) exposure.
- c. IRIS DATA BASE
- d. USEPA ORD Health Effects Assessment Summary Tables (HEAST) FY 1989, 4th Quarter.
- e. RfD derived from the USEPA drinking water standard as listed in USEPA 1989 HEAST 2nd Quarter report.
- f. In the absence of toxicity data, the RfDs for 1,1-Dichloroethylene have been adopted for 1,2-Dichloroethylene.
- g. In the absence of toxicity data, the RfDs for PCE have been adopted for TCE.
- h. In the absence of toxicity data, the RfDs for 1,1-Dichloroethane have been adopted for 1,2-Dichloroethane.
- j. RfDs or potency factors for the oral exposure route have been used in the absence of toxicity data for the inhalation route.
- k. In the absence of toxicity data, the reference dose for tetrachloroethylene is used for trichloroethylene.
- m. Reference dose for lead is under evaluation by EPA. The RfD listed is this table has been used in the absence of a more recent toxicity measure.
- p. In the absence of toxicity data, the inhalation RfDs for 1,1,1-Dichloroethane have been adopted for 1,1,2-Dichloroethane.
- q. Reference dose for vinyl chloride was derived from the EPA ODW longer-term drinking water health advisory.
- r. In the absence of toxicity data, the reference dose for trichlorotrifluoromethane has been adopted.
- . RfD for chronic exposure to 70 kg adult derived from EPA ADI of 0.025 mg/day. Drinking Water Criteria Document for Benzene (USEPA 1985), EPA ODW.
- . In the absence of toxicity data, the reference doses for 1.1-dichloroethane has been adopted.

factor (which mathematically is the slope of the dose-response curve) for each chemical. To derive an estimate of risk, the carcinogenic potency factor ( $q_1*$  - defined below) is then multiplied by the estimated chronic daily dose experienced by the exposed individual:

# Risk = CDI $x q_1^*$

where

Risk = Upper bound estimate of the excess lifetime cancer risk to an indivdual (unitless probability).

 $q_1*$  = 95% upper-bound estimate of the slope of the dose-response curve (mg/kg body weight/day)⁻¹

The slope factor  $q_1^*$  is used to convert estimates of daily intake or dose averaged over a lifetime, to incremental excess risk of an individual developing cancer. EPA notes that use of this equation assumes that the dose-response relationship is linear in the low-dose portion of the multistage model dose-response curve (USEPA 1989a: A linearized multistage dose response model is most commonly used by EPA in deriving the slope estimates.) Given this assumption, the slope factor is a constant and risk is directly proportional to intake.

EPA indicates that use of the linear equation (above) for risk estimation is valid only at risk levels  $< 1 \times 10^{-2}$ . The Agency recommends use of the following equation (based on the "one-hit" model of carcinogenesis) as an alternative at sites where exposure and intakes are projected to be quite high, and risk levels may exceed  $1 \times 10^{-2}$ .

Risk = 1 - 
$$\exp(-CDI \times q_1^*)$$

In evaluating risk of exposure to more than one carcinogen, the risk measure for each compound may be summed (in the absence of information on antagonistic or synergistic effects) to provide an overall estimate of total carcinogenic risk (USEPA 1989a).

$$Risk_T = \sum_{i=1}^{n} Risk_i$$

where

Risk_T = The combined excess lifetime cancer risk across chemical carcinogens.

and,

 $Risk_i$  = The risk estimate for the ith chemical of n chemicals under evaluation.

This is conducted for each source of environmental release, associated exposure pathway, and receptor group at risk of exposure. Population risks are derived by multiplying the overall risk level (summed for all subject chemicals) by the number of people exposed. This would yield a measure of the additional incidence of developing cancer (i.e., additional number of new cases) in the exposed population over a lifetime (i.e., 70 years) of exposure.

The traditionally accepted practice of evaluating exposure to noncarcinogenic compounds has been to experimentally determine a NOAEL and to divide this by a safety factor to establish an acceptable human dose, for example, acceptable daily intake or RfD (NRC 1983). The RfD is then compared to the average daily dose experienced by the exposed population to obtain a measure of concern for adverse noncarcinogenic effects:

$$HQ = \frac{Dose}{RfD}$$

where

HQ = Hazard Quotient: potential for adverse noncarcinogenic
effects

Dose = average daily dose for subchronic or chronic exposure (mg/kg body weight/day) and.

Dose and the RfD are expressed in the same units and are based upon common exposure periods (i.e., chronic, subchronic, or shorter-term). If HQ is > 1, then there may be potential for adverse noncarcinogenic effects at the given exposure/dose level. Guidelines for evaluating exposure to mixtures of noncarcinogens is presented by EPA (USEPA 1986b, USEPA 1989a). Essentially, this involves summing the hazard quotient (ratios of daily dose/RfD) for all chemicals under evaluation. If the sum of these ratios, called the Hazard Index (HI) is > 1, then there is the potential for adverse noncarcinogenic effects. Under these circumstances, EPA recommends segregating the compounds into groups of like or common toxicological effects, and again to evaluate the potential for manifestation of the various adverse health effects identified.

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# APPENDIX B-1 TECHNOLOGY DESCRIPTIONS

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#### APPENDIX B. TECHNOLOGY DESCRIPTIONS

#### Solidification

#### o In-situ Vitrification

In-situ vitrification is a technology being developed for the stabilization of transuranic contaminated wastes, and has conceivable applicable to other hazardous wastes. Several laboratory-scale and pilot-scale tests have been conducted, and a large-scale testing system is currently being fabricated. The technology is based upon electric melter technology, and the principle of operation is joule heating, which occurs when an electrical current is passed through a molten mass. Contaminated soil is converted into durable glass, and wastes are paralyzed or crystallized. Off-gases released during the melting process are trapped in an off-gas hood. The depth of the waste is a significant limiting factor in the application of this technology.

# o Solidification/Stabilization

Solidification and stabilization are terms which are used to describe treatment systems which (1) improve waste handling or other physical characteristics of the waste, (2) decrease the surface area across which transfer of contaminants can occur and/or (3) limit the solubility or toxicity of contaminants. Solidification is used to describe processes where these results are obtained primarily, but not exclusively, by production of a monolithic block of waste with high structural integrity. The contaminants do not necessarily interact chemically with the solidification reagents, but are mechanically locked within the solidified matrix. Contaminant loss is minimized by reducing the surface area. Stabilization methods usually involve the addition of materials which limit the solubility or mobility of waste constituents even though the physical handling characteristics of

the waste may not be improved. Methods involving combinations of solidification and stabilization techniques are often used. The state-of-the-art of solidification/stabilization methods is advancing rapidly. Many manufacturers are marketing processes which involve the use of various combinations of alkaline earth materials often together with organic polymers and proprietary chemicals.

#### o Cement-based Solidification

Cement-based solidification involves mixing the wastes directly with Portland cement. The waste is incorporated into the rigid matrix of the hardened concrete. The end product may be a standing monolithic solid or may have a crumbly, soil-like consistency, depending upon the amount of cement added.

Most hazardous wastes slurried in water can be mixed directly with cement and the suspended solids will be incorporated into the rigid matrix. Although cement can physically incorporate a broad range of waste types, most wastes will not be chemically bound and are subject to leaching. Cement solidification is most suitable for immobilizing metals because at the pH of the cement mixture, most multivalent cations are converted into insoluble hydroxides or carbonates.

There are many disadvantages to cement-based solidification. Metal hydroxides and carbonates are insoluble only over a narrow pH range and are subject to solubilization and leaching in the presence of even mildly acidic leaching solutions (i.e., rain). Portland cement alone is not effective in immobilizing organics. Cement-based solidification results in wastes that are twice the weight and volume of the original material thereby increasing transportation and disposal costs. Some wastes are incompatible with cement such as some sodium salts (i.e., arsenate, borate, phosphate, iodate, and sulfide), salts of magnesium, tin, zinc,

copper, and lead, organic matter, some silts and clays, coal and lignite. The major advantage of the method is its low cost and the use of readily available mixing equipment.

#### o Silicate-Based Solidification

Silicate based processes refer to a very broad range of solidification and stabilization methods which use a siliceous material together with lime, cement, gypsum, and other suitable setting agents. Extensive research is currently underway on the use of siliceous compounds in solidification. Many of the available processes use proprietary additives and claim to stabilize a broad range of compounds. The basic reaction is between the silicate material and polyvalent metal ions. silicate material which is added in the waste may be fly-ash, blast furnace slag or other readily available materials. silicates such as sodium silicate or potassium silicate are also The polyvalent metal ions which act as initiators of silicate precipitation and/or gelation come either from the waste solution, an added settling agent, or both. The setting agent should have low solubility, and a large reserve capacity of metallic ions so that it controls the reaction rate. cement and lime are most commonly used because of their ready availability. However, gypsum, calcium carbonate, and other compounds containing aluminum, iron, magnesium are also suitable. The solid which is formed in these processes varies from a moist, clay-like material to a hard-dry solid similar in appearance to There are a number of silicate-based processes which are currently available or in the research stages. Manufacturers' claims differ significantly in terms of the capabilities of these processes for stabilizing different waste constituents.

One of the major limitations with silicate based processes is that a large amount of water which is not chemically bound

will remain in the solid after solidification. In open air, the liquid will leach until it comes to some equilibrium moisture content with the surrounding soil. Because of this water loss, the solidified product is likely to require secondary containment.

Commercial cement mixing and handling equipment can generally be used for silicate-based processes. A number of mobile, trailer mounted systems are available.

#### o Sorbents

Sorbents include a variety of natural and synthetic solid materials which are used to eliminate free liquid and improve the handling characteristics of wastes. Commonly used natural sorbent materials include fly ash, kiln dust, vermiculite, and bentonite. Synthetic sorbent materials include activated carbon which sorbs dissolved organics, Hazorb (Dow Chemical) which sorbs water and organics and Locksorb (Redecca Corporation) which is reportedly effective for all emulsions.

Sorbents are widely used to remove free liquid and improve waste handling. Some sorbents have been used to limit the escape of volatile organic compounds. They may also be useful in waste containment when they modify the chemical environment and maintain the pH and redox potential to limit the solubility of wastes. Although sorbents prevent drainage of free water, they do not necessarily prevent leaching of waste constituents and secondary containment is generally required. Equipment requirement for addition and mixing of sorbents are simple.

#### o Thermoplastic Solidification

Thermoplastic solidification involves sealing wastes in a matrix such as asphalt bitumen, paraffin, or polyethylene. The waste is dried, heated, and dispensed through a heated plastic

matrix. The mixture is then cooled to form a rigid but deformable solid. Bitumen solidification is the most widely used of the thermoplastic techniques.

Thermoplastic solidification involving the use of an asphalt binder is most suitable for heavy metal or electroplating wastes. Relative to the cement solidification, the increase in volume is significantly less and the rate of leaching significantly lower. Thermoplastics are not affected significantly by either water or microbial action

There are a number of waste types which are incompatible with thermoplastic solidification. Oxidizers such as perchlorates or nitrates can react with many of the solidification materials to cause an explosion. Some solvents and gases can cause asphalt materials to soften and never become Xylene and toluene diffuse quite rapidly through asphalt. Salts that partially dehydrate at elevated temperatures can be a Sodium sulfate hydrate, for example, will loose some water during asphalt incorporation and if the waste asphalt mix containing the partially dehydrated salt is soaked in water, the mass will swell and crack due to rehydration. This can be avoided by eliminating easily dehydrated salts or coating the outside of the waste/asphalt mass with pure asphalt. and complexing agents can cause problems with containment of heavy metals. Certain wastes, such as tetraborates, and iron and aluminum salts can cause premature solidification and plug up the mixing machinery.

High equipment and energy costs are principal disadvantages of thermoplastic solidification. Another problem is that the plasticity of the matrix-waste mixture generally require that containers be provided for transportation and disposal of materials which greatly increases the cost. Thermoplastic

solidification requires specialty equipment and highly trained operators to heat and mix the wastes and solidifier. The common range of operating temperatures is 130 to 230 degrees centigrade. The energy intensity of the operation is increased by the requirement that the wastes be thoroughly dried before solidification.

# o Surface Microencapsulation

Surface encapsulation includes those methods which physically microencapsulate wastes by sealing them in an organic binder or resin. Surface encapsulation can be accomplished using a variety of approaches.

A process developed by Environmental Protection Polymers involves the use of 1,2-polybutadiene and polyethylene to produce a microencapsulated waste block onto which a high density polyethylene (HDPE) jacket is fused. The 1,2-polybutadiene is mixed with particulated waste which yields, after solvent evaporation, free flowing dry resin-coated particulates. resulting polymers are resistent to oxidative and hydrolytic degradation and to permeation by water. The next step involves formation of a block of the polybutadiene/waste mixture. final step, a 1/4 inch thick HDPE jacket is mechanically and chemically locked to the surface of the microencapsulated waste. An alternative process developed by the same company involves a similar approach. Contaminated solids or sludges are loaded into a high density polyethylene overpack. A portable welding apparatus in then used to spin weld a lid onto the container forming a seam free encapsulate.

Another encapsulation method uses an organic binder to seal a cement-solidified mass. United States Gypsum Company manufactures a product called Envirostone Cement which is a special blend of high-grade polymer modified-gypsum cement.

Emulsifiers and ion exchange resins may be added along with the gypsum cement which hydrates to form a freestanding mass. A proprietary organic binder is used to seal the solidified mass. The process can be used to stabilize both organic and inorganic wastes.

The major advantage of encapsulation processes is that the waste material is completely isolated from leaching solutions. These methods can be used for both organic and inorganic waste constituents. They allow for efficient space utilization during transport, storage and disposal. The hazard of accidental spills during transport is eliminated. Encapsulation materials are commercially available, very stable chemically, nonbiodegradable, mechanically tough and flexible. They can withstand the mechanical and chemical stresses of a wide range of disposal schemes.

The disadvantages of encapsulation techniques include the high cost of the binding resins and that the processes are energy intensive. In addition skilled labor is required to operate molding and fusing equipment.

#### o Vitrification

Vitrification of wastes involves combining the wastes with molten glass at a temperature of 1,350 degrees centigrade or greater. There are some processes that allow temperatures as low as 850 degrees centigrade.

Vitrification is quite costly and so far has been restricted to radioactive or very highly toxic wastes. To be considered for vitrification, the wastes should be either stable or totally destroyed at the process temperature.

Vitrification offers the greatest degree of containment of all the common solidification methods. Most resultant solids have an extremely low leach rate. Some glasses, such as borate-based glasses, have high leach rates and exhibit some water solubility. The high energy demand and requirements for specialized equipment and trained personnel greatly limit the use of this method.

# **Bioreclamation**

Microorganisms, like all living organisms, require specific inorganic nutrients (i.e., nitrogen, phosphate-phosphorus, trace metals), and a carbon and energy source to survive.

Bioreclamation relies upon microbial metabolic activity to convert toxic substances to a more desirable form. Indigenous microorganisms can generally be relied upon to degrade a wide range of compounds given an adequate living conditions.

Specially adapted or genetically manipulated microorganism are also available. The technology of in-situ bioreclamation involves implementing methods to optimize environmental conditions to the subsurface to enhance microbial activity. This can include an injection well, an infiltration system or other techniques to provide oxygen, provide nutrients, control temperature or modulate any other parameter that can enhance microbial activity.

Bioreclamation cam be expected to reduce the concentration of only those organic compounds which are amenable to biological degradation. These are compounds that are either substrates for microbial growth and metabolism, or are cometabolically broken down as the microorganism uses another primary substrate as its carbon and energy source. Microbial metabolic activity can be classified into three main categories: aerobic respiration, in which oxygen is required as a terminal electron acceptor; anaerobic respiration, in which sulfate or nitrate serves as a

terminal electron acceptor; and fermentation, in which the microorganism rids itself of excess electrons by exuding reduced organic compounds.

The bioreclamation method that has been most developed for in-situ treatment is one which relies on aerobic (oxygen requiring) microbial processes. For most compounds, the most rapid and complete degradation occurs aerobically. It can be generalized that for the degradation of petroleum hydrocarbons, aromatics, halogenated aromatics, polyaromatic hydrocarbons, phenols, halophenols, biphenyls, organophosphates, and most pesticides and herbicides, aerobic bioreclamation techniques are most suitable. Extensive data on the biodegradabilities of substances can be found in the literature. Relative aerobic biodegradability of compounds can also be estimated using laboratory data associated with biological, chemical and ultimate oxygen demand (i.e., BOD, COD, UOD). In most instances, treatability studies are required to determine degradability of specific contaminants.

Aerobic bioreclamation has been demonstrated to be effective in degrading organics at more than 30 spill sites. Although it has not yet been demonstrated at hazardous waste sites, it can be expected to be effective and reliable provided the organics are amenable to aerobic degradation and the hydraulic conductivity of the aquifer is sufficiently high. There are substantial research data to suggest that microorganisms found at uncontrolled hazardous waste sites are well-acclimated to the wastes.

Anaerobic treatment is generally not as promising for site remediation as aerobic treatment. Anaerobic processes are slower; fewer compounds can be degraded, and the logistics of rendering a site anaerobic have not been developed to date.

Anaerobic degradation under reducing conditions appears to be the

most suitable process for halogenated lower molecular weight hydrocarbons, such as unsaturated alkyl halides like PCE and TCE, and saturated alkyl halides like 1,1,1-trichloroethane and trihalomethane. Some lower molecular weight halogenated hydrocarbons, will only degrade anaerobically.

Relative to conventional pump and treat methods, bioreclamation may be more effective since it is capable of degrading organics sorbed to soils. Sorbed organics are not removed using conventional pump and treat methods.

# Chemical Treatment

Chemicals can be used to immobilize, mobilize (for extraction) or detoxify subsurface organic and inorganic contaminants. Technologies placed in the category "immobilization" include precipitation, chelation, and polymerization. The category encompassing methods for mobilizing contaminants for extraction is termed "soil flushing." Flushing agents include surfactants, dilute acids and bases, and water. Detoxification techniques include oxidation, reduction, neutralization, and hydrolysis. These categories do not define the limits of each technology, as a technique implemented primarily for one objective may simultaneously perform one or more others.

In-situ chemical treatment covers a wide range of methods. Generalizations regarding the feasibility and effectiveness of these methods are not possible. However, all these methods are developmental or conceptual and none have been fully demonstrated for hazardous waste site remediation. Off all the methods that will be described, soil flushing methods involving the use of water surfactants appear to be the most feasible for organics. They can use relatively cheap, innocuous treatment reagents, can be used to treat a broad range of waste constituents, and do not

result in toxic degradation products. The most feasible methods for treating inorganics in-situ include soil flushing with dilute acids, chelating agents or other treatment agents which will mobilize the metals.

The feasibility of an in-situ chemical treatment approach is dictated by site geology and hydrology, soil characteristics, and waste characteristics. Since the application of many chemical in-situ treatment techniques to hazardous waste disposal site reclamation is conceptual or in the developmental stage, there is little hard data available on the specific site characteristics that may limit the applicability of each method. Some of the site and soil characteristics considered important in evaluating the treatment applicability are as follows:

- o Site location/topography
- o Slope of site-degree and aspect
- o Soil, type and extent
- o Hydraulic properties and conditions
- o Climatological factors

The chemical treatment approaches generally involve the delivery of a fluid to the subsurface. Therefore, the same factors that limit the use of injection/extraction wells, drains, or surface gravity application systems will limit the applicability of most in-situ chemical treatment approaches. Minimal permeability requirements must be met if the treatment solution is to be delivered successfully to the contaminated zone. Sandy soils are far more amenable to in-situ treatment than clayey soils. Further, the contaminated groundwater must be contained within the treatment zone. Measures must be taken to ensure that treatment reagents do not migrate and, of themselves, become contaminants. Care must be taken during the extraction

process not to increase the burden of contaminated water by drawing uncontaminated water into the treatment zone from the aquifer or from hydraulically connected surface waters.

Potential chemical reaction of the treatment reagents with the soils and wastes must be considered. Most hazardous waste disposal sites contain a mix of contaminants. A treatment approach that may neutralize one contaminant may render another more toxic or mobile; for example, chemical oxidation will destroy or reduce the toxicity of many toxic organics, but chromium III, if present, will oxidize to the more toxic and mobile chromium VI state. The permeability of soils may be reduced by the treatment approach. In soils high in iron or manganese; for example, oxidizing the subsurface could result in the precipitation of iron and manganese oxides and hydroxides, which could clog the delivery system and the aquifer.

### o Soil Flushing

Soil flushing (i.e., solvent flushing, ground leaching, or solution mining) is an extraction process that washes organic and inorganic contaminants from the soil. Water or an aqueous solution is injected into the area of contamination, and the contaminated elutriate is pumped to the surface for removal, recirculation, or on-site treatment and reinjection. During elutriation, sorbed contaminants are mobilized into solution, formation of an emulsion, or by chemical reaction with the flushing solution. Solutions with the greatest potential for use in soil flushing are (1) water, (2) acids-bases, (3) complexing and chelating agents, (4) surfactants and (5) reducing agents. Soil flushing may involve the recycling of elutriate through the contaminated material, with make-up solvent being added to the system while a fraction of the elutriate stream is routed to a wastewater treatment system.

Water can be used to flush water-soluble or water-mobile organics and inorganics. Hydrophilic organics are readily solubilized in water. Organics amenable to water flushing can be identified according to their soil/water partition coefficient, or estimated using the octanol/water coefficient. High solubility organics, such as lower molecular weight alcohols, phenols, and carboxylic acids very amenable to this technique. Medium solubility organics which could be effectively removed from soils by water flushing include low to medium molecular weight ketones, aldehydes, and aromatics, and lower molecular weight halogenated hydrocarbons. Inorganics which can be flushed from soil with water are soluble salts such as the carbonates of nickel, zinc, and copper. Adjusting the pH with dilute solutions of acids or bases will enhance inorganic solubilization and removal.

Dilute solution of acids have been widely used in industrial processes to extract metal ions. Solutions of sulfuric, hydrochloric, nitric, phosphoric, and carbonic acid are used in industrial applications to dissolve basic metal salts. However, because of the toxicity of many acids, it is desireable to use weak acids for in-situ treatment. Acidic solutions may serve to flush some basic organics such as amines, ethers, and anilines.

Complexing and chelating agents may also find use in a solution mining removal system for heavy metals. Chelating agents used for in-situ treatment must result in a stable metal-chelate complex which is resistant to decomposition and degradation. Another possibility for mobilizing metals which are strongly adsorbed to manganese and iron oxides in soils is to reduce the metal oxides, resulting in release of the heavy metal solution. Chelating agents or acids can then be used to keep the metals in solution.

Surfactants can be used to improve the solvent property of the recharge water, emulsify nonsoluble organics, and enhance the removal of hydrophobic organics sorbed onto soil particles. Surfactants improve the effectiveness of contaminant removal by improving both the detergent properties of aqueous solutions and the efficiency by which organics may be transported by aqueous solutions. Surfactant washing is among the most promising of the in-situ chemical treatment methods.

Numerous environmentally safe and relatively inexpensive surfactants are commercially available. Use of surfactants to date has been restricted to laboratory research. Most of the research has been performed by the petroleum industry for tertiary oil recovery. Aqueous surfactants have also been proposed for gasoline cleanup. In a study performed by the Texas Research Institute for the American Petroleum institute, a mixture of an anionic and nonionic surfactants result in contaminant recovery of up to 40 percent. In a laboratory study conducted by Ellis and Payne, crude oil recovery was increased from less than 1 percent to 86 percent, and PCB recovery was increased from less than 1 percent to 68 percent when soil columns were flushed with an aqueous surfactant solution.

- o Immobilization (see in-situ containment)
- o Detoxification

Detoxification techniques are treatments that destroy, degrade, or otherwise reduce the toxicity of contaminants. The techniques include neutralization, hydrolysis, oxidation/reduction, enzymatic degradation, and permeable treatment beds. The techniques are applicable to specific chemical contaminants, therefore, uses of these in-situ techniques at waste sites will be limited.

Neutralization involves injecting dilute acids or bases into the groundwater to adjust the pH. This pH adjustment can serve as pretreatment prior to in-situ biodegradation, oxidation, or reduction. It can be used to neutralize acidic or basic plumes that need no other treatment, or to neutralize groundwater following another treatment. It an also be used during oxidation, reduction, or precipitation to prevent the formation of toxic gases including hydrogen sulfide and hydrogen cyanide.

The pH adjustment can also be used to increase the hydrolysis rate of certain organics. The rate of hydrolysis an be increased up to one order of magnitude for a change of one standard unit in pH. Classes of compounds with potential for insitu degradation by hydrolysis include: esters, amides, carbamates, phosphoric and phosphonic acid esters, and pesticides. Because a hydrolysis product may be more toxic than the present compound, the pathways for reactions must be determined to ensure toxic products are not produced. A collection system should be incorporated as a fail safe measure with this technique to prevent migration of the treatment reagents and any contaminants which are not successfully treated.

Oxidation and reduction reactions serve to alter the oxidation state of a compound through loss or gain of electrons, respectively. Such reactions can detoxify, precipitate, or solubilize metals, and decompose, detoxify, or solubilize organics. Oxidation may render organics more amenable to biological degradation. Oxidation/reduction techniques are standard wastewater treatment approaches, but their application as in-situ treatment technologies is conceptual.

Oxidation of inorganics in soils, is for all practical purposes limited to oxidation of arsenic and possibly some lead compounds. The in-situ oxidation of arsenic compounds with

potassium permanganate has been used to successfully reduce the arsenic concentrations in groundwater in Germany. Three oxidizing agents, of the large number that are available, have been considered potentially useful in the in-situ detoxification of organics in groundwater and soil: hydrogen peroxide, ozone, and hypochlorites. Each can react with a broad range of organics and could potentially oxidize a number of different organic contaminants in a hazardous waste site. Selection of the appropriate oxidizing agent is dependent in part upon the substance or substances to be detoxified, but also upon feasibility of delivery and environmental safety. Although there are some compounds that will not react with hydrogen peroxide but will react with ozone or hypochlorite, hydrogen peroxide appears to be the most feasible for in-situ treatment.

Ozone gas is a very strong oxidizing agent that is very unstable and extremely reactive. It cannot be shipped or stored; therefore, it must be generated on-site. Ozone rapidly decomposes and its half-life in groundwater is only 18 minutes. Ozone is used in the treatment of drinking water, municipal wastewater, and industrial waste, but has never been used in the treatment of contaminated soils or groundwater.

Hypochlorite, generally available as potassium, calcium, or sodium hypochlorite (bleach) is also used in the treatment of drinking water, municipal wastewater, and industrial waste. Hypochlorites have never been used in the treatment of contaminated groundwater or soils. The reaction of many organics with hypochlorite results in the formation of chlorinated organics which can be as more toxic than the original contaminant. The formation of lower molecular weight chlorinated organics in drinking water form hypochlorite treatment for disinfection purposes has become a major concern of the drinking water industry.

Hydrogen peroxide, a moderate strength chemical oxidant, is used routinely in municipal wastewater treatment to control various factors of biological treatment, and is also used in industrial waste treatment to detoxify cyanide and various organic pollutants. Hydrogen peroxide is commercially available in aqueous solutions of several concentrations and is miscible in water at all concentrations. It has been delivered successfully in dilute solutions to the subsurface as an oxygen source in a bioreclamation project.

Chemical reduction does not appear to be as promising as oxidation for the treatment of organics. Its effectiveness in soils has not been demonstrated. Chemical reduction does, however, appear promising for treatment of chromium and selenium in soils. The in-situ reduction of hexavalent to divalent chromium has been accomplished in Arizona well water using minute quantities of reducing agent.

There are a number of disadvantages with the use of oxidizing and reducing agents which limit their use at hazardous waste sites. The treatment compounds are non-specific and this may result in degradation of non-targeted compounds. There is a potential, particularly with oxidation, for the formation of more toxic or more mobile degradation products. Also, the introduction of these chemicals into the groundwater system may create a pollution problem in itself.

Enzymatic degradation of organics with cell-free enzymes holds potential as a possible in-situ treatment technique. Purified enzyme extracts, harvested from microbial cells, are commonly used in industry to catalyze a variety of reactions, including the degradation of carbohydrates and proteins. A bacterial enzyme preparation has been used to detoxify organophosphate waste from containers. Parathion hydrolase has

been tested under field conditions in the degradation of the pesticide diazinon and has been found to effectively reduce concentrations in soil.

Permeable treatment beds are essentially excavated trenches placed perpendicular to groundwater flow and filled with an appropriate material to treat the plume as it flows through the material. Some of the materials that may be used in the treatment bed are limestone, crushed shell, activated carbon, glauconitic green sands, and synthetic ion exchange resins. Permeable treatment beds have the potential to reduce the quantities of contaminants present in leachate plumes. The system is applicable to relatively shallow groundwater tables containing a plume. To date, the application of permeable treatment beds at hazardous waste sites has not been performed.

### Physical In-situ Methods

A number of methods are currently being developed which involve physical manipulation of the subsurface in order to immobilize or detoxify waste constituents. These technologies, which include in-situ heating, vitrification and ground-freezing, are in the early stages of development and detailed information is not available.

#### o Heating

In-situ heating has been proposed as a method to destroy or remove organic contaminants in the subsurface through thermal decomposition, vaporization, and distillation. Methods recommended for in-situ heating are steam injection and radio frequency heating.

The radio frequency heating process has been under development since the 1970s. Field experiments have been conducted for the recovery of hydrocarbons. The method involves

laying a row of horizontal conductors on the surface of a landfill and exciting them with an RF generator through a matching network. The decontamination is accomplished in a temperature range of 300 to 400 degrees centigrade, assisted with steam, and requires a residence time of about two weeks. A gas or vapor recovery system is required on the surface. Excavation, mining, drilling, or boring is not required. This method appears very promising for certain situations involving contamination with organics, although more research is necessary.

# o Freezing

Artificial ground freezing involves the installation of freezing loops in the ground and a self-contained refrigeration system that pumps coolant around the freezing loop. Although never used in an actual waste contaminant operation, the technology is being used increasingly as a construction method in civil engineering projects. Artificial ground freezing is done not on the waste itself, which may have a freezing point much lower than that of the soil systems, but on the soil surrounding the hazardous waste. It renders the soil practically impermeable, but is useful only as a temporary treatment approach because of the thermal maintenance expense.

# o Vitrification (In-situ)

See discussion in-situ containment technologies.

#### Soil Washing

Soil washing is a process whereby excavated contaminated soil is washed with water to remove the contamination from the soil grains into the washwater. Chemical agents such as surfactants or chelants can be added to the washwater to increase the efficiency of contaminant removal. There is little or no actual experience with washing of excavated soil at hazardous

waste sites in the United States. A few projects in the planning stages are reported. The soil-washing process has been used in several installations in Holland and West Germany. The process has been the subject of a U.S. EPA research program since about 1982, and at least one private firm (ECOVA) in the U.S. is attempting to market the process. In Europe soil-washing facilities are reported in Germany and the Netherlands.

The soil washing process consists of the following steps. First, the soil feed is screened to remove debris. The soil is then mixed with washwater in measured proportions. It is washed or scrubbed to obtain intensive contact between the soil grains and the washwater. Energy may be introduced into the mixture by high-pressure water jets, vibration devices, and/or other means. Next the washed soil is separated out of the washwater. Coarse soil particles can be separated in a trammel or vibrating screen device; finer sand separated in a sedimentation tank; and silt in a hydrocyclone or centrifuge device. The resulting fine soil and contaminated water mixture must then be treated for final disposal of solids and recycling of the water.

Soil-washing works successfully to clean coarse-grained soils of a wide range of organic and inorganic contaminants. It removes most water-soluble volatile organics and other highly mobile hydrophilic compounds from soil. The soil-washing process has great difficulty removing from fine-grained soils those organics and inorganic compounds which do not readily separate from the soil to water. There is a minimum soil grain size below which soil-washing cannot effectively remove metals and most nonvolatile and semivolatile organics. The addition of chelants and surfactants will somewhat reduce the minimum soil grain size which can be successfully cleaned. The addition of the chemicals to the washwater complicates the later treatment of the washwater for recycle or disposal.

Despite the lack of U.S. experience and limited European experience with soil-washing there is nothing to imply reliability problems. The equipment used for soil-washing is similar to equipment routinely used in the sand, gravel, and ore-processing industry. Good reliability is likely the soil-washing equipment is designed for the site soil and if properly maintained.

## Thermal Destruction

Thermal destruction is a treatment method which uses high temperature oxidation under controlled conditions to degrade a substance into products that generally include carbon dioxide, water vapor, sulfur dioxide, nitrogen oxides, hydrogen chloride gas and ash. The hazardous products of the thermal destruction/incineration include all the previously mentioned products expect carbon dioxide and water vapor, plus incomplete products of combustion and they require air pollution equipment to control their release. Thermal destruction methods can be used to destroy organic contaminants in liquid, gaseous and solid waste streams. The most common incineration technologies applicable to hazardous waste sites are rotary kiln, multiple hearth, fluidized bed and liquid incineration. Advanced incineration technologies include molten salt, wet air oxidation, plasma arc torch, circulating bed, high temperature fluid wall, pyrolysis, supercritical water, electric tube reactor and vertical tube reactor. Many of these advanced technologies show promise and have been demonstrated to varying degrees, with a wide range of applicabilities, limitations and reliabilities. They are not presented here for conciseness and to allow focus on the most significant incineration technologies. However, they are well documented in the literature and should be evaluated if thermal treatment is included in the remedial action.

# o Rotary Kiln

Rotary kilns are capable of handling a wide variety of solid and liquid wastes. They are cylindrical, refractory-line shells that are fueled by natural gas, oil, or pulverized coal. Most of the heating of the waste is due to heat transfer with the combustion product gases and the walls of the kiln. The basic type of rotary kiln incinerator, consists of a kiln and an afterburner.

Wastes are injected into the kiln at the higher end and are passed through the combustion zone as the kiln rotates. The rotation creates turbulence and improves combustion. Rotary kilns often employ afterburners to ensure complete combustion. Most rotary kilns are equipped with a wet scrubber for acid gas and possibly particulate emission control.

Rotary kilns are capable of burning wastes in any physical form. They can incinerate solids and liquids independently or in combination and can accept waste feed without any preparation. Wastes that have been treated in rotary kilns include PCBs, tars, obsolete munitions, polyvinyl chloride, and bottoms from solvent reclamation operations. Because of their ability to handle waste in any physical form, and their high incineration efficiency, rotary kilns are the preferred method for treating mixed hazardous solid residues.

Rotary kilns are susceptible to thermal shock, which necessitates very careful maintenance. The need additional air due to leakage, have high particulate loadings, relatively low thermal efficiency and a high capital cost.

# o Multiple Hearth

Multiple hearth incinerators consist of a refractory lined steel shell, a rotating central shaft, a series of solid flat

hearths, a series of rabble arms with teeth for each hearth, an air blower, waste feeding and ash removal systems, and fuel burners mounted on the walls. They also have an afterburner and can have liquid waste burners, and side ports for tar injections.

The multiple hearth incinerator an be used for the disposal of all forms of combustible materials, including sludges, tars, solids, liquid and gases. The incinerator is best suited for sludge destruction. Solid waste often requires pretreatment such as shredding and sorting. It can treat the same wastes as the rotary kiln provided that solids are pretreated. The principal advantages of multiple hearth incineration include high residence time for sludge and low volatile materials; the ability to handle a variety of sludges; the ability to evaporate large amounts of water; high fuel efficiency and the utilization of a variety of fuels.

Multiple hearth units are susceptible to thermal shock. They are unable to handle wastes that produce and ash which fuses into large rock-like structures and wastes requiring very high temperatures. Control of the firing of supplemental fuels in difficult. This type of incinerator has high maintenance and operating costs.

#### o Fluidized Bed

Fluidized bed incinerators consist of a cylindrical vertical refractory lined vessel containing a bed of inert granular material, usually sand on a perforated metal plate. Combustion air is introduced through a plenum at the bottom of the incinerator and rises vertically fluidizing the bed and maintaining turbulent mixing of bed particles. Waste material is injected into the bed and combustion occurs within the bubbling bed. Heat is transferred from the bed into the injected wastes. Auxiliary fuel is usually injected into the bed. Since the mass

of the heated, turbulent bed is much greater than the mass of the waste, heat is rapidly transferred to the waste materials; a residence time of a few seconds for gases and a few minutes for liquids is sufficient for combustion.

The most typical wastes being treated in fluidized beds include slurries and sludges. Some waste require pretreatment such as drying, shredding and sorting. The fluidized bed can handle the same wastes as the rotary kiln. They have been used for the disposal of municipal wastewater treatment sludges, oil refinery waste, and pulp and paper mill waste. There is only limited data on the use of this technology for hazardous waste incineration. It has been used for phenolic wastes and methyl methacrylate. It is particularly well suited for high-moisture wastes, sludges, and wastes containing large quantities of ash.

The advantages of fluidized bed incineration include simple design, minimal NOx formation, long life of the incinerator, high efficiency and simplicity of operation. It has the ability to trap some gases in the bed, reducing the need for an emission control system. The disadvantages included difficulty in removing residual materials from the bed, a relatively low throughput capacity, and the difficulty of handling residues and ash from the bed costs.

# o Liquid Injection

A liquid incineration system consists of a single or double refractory-line combustion chamber and a series of atomizing nozzles. Two chamber systems are more common. The primary chamber is usually a burner where combustible liquid and gaseous wastes are introduced. Noncombustible liquid and gaseous wastes are introduced downstream of the burner in the secondary chamber.

Liquid injection can be used to destroy virtually any pumpable waste. If viscosity precludes atomization, mixing and heating can be used to prior to atomization. These units have been used in the destruction of PCBs, solvents, still and reactor bottoms, polymer wastes, and pesticides. Unlikely candidates for destruction include heavy metal wastes and wastes high in inorganics.

Liquid incinerators have no moving parts and require the least maintenance of all types of incinerators. The major limitations of these units are its ability to incinerate only wastes which can be atomized in the burner nozzle and the burner's susceptibility to clogging. It also needs supplemental fuel. Liquid injection incinerators are highly sensitive to waste composition and flow changes. Storage and mixing tanks are usually required to ensure a reasonably steady and homogenous waste flow.

# Excavation Technologies (contaminated soil only)

Excavation and removal followed by land disposal or treatment are performed extensively in hazardous waste site remediation. There are no absolute limitations on the types of waste which can be excavated and removed. However, worker health and safety weighs heavily in the decision to excavate explosive, reactive, or highly toxic waste material. Other factors which are considered include the mobility of the wastes, the feasibility of on-site containment of in-situ treatment and the cost of disposing the waste or rendering it non-hazardous once it has been excavated. A frequent practice at hazardous waste sites is to excavate and remove contaminant "hot spots" and to use other remedial measures for less contaminated soils. Excavation and removal is applicable to almost all site conditions, although it may become cost-prohibitive at great depths or in complex hydrogeologic environments.

The nature and extent of preventative and mitigative measures required for controlling environmental releases during excavation and removal are site specific, although there are a number of general procedures that apply to all sites. Operating areas for staging and treating drummed wastes and contaminated soils should at a minimum be graded to prevent puddling; lined with polyethylene or clay; and bermed or diked. Where temporary impoundments must be used to store liquids, it may be acceptable to provide a thick clay liner and to excavate the contaminated soils after use of the impoundment is completed.

As soils are being excavated on-site, air monitoring should be conducted to determine unsafe levels of various constituents in the ambient air. Numerous portable direct reading instruments are available. As contaminated soils are excavated from the disposal area, they should be transferred to box truck or to a temporary storage area, preferably a diked or bermed area lined with plastic or low permeability clay. A layer of absorbent material should be placed on the bottom of the temporary storage area.

Excavation and removal can almost totally eliminate the contamination at a site and the need for long-term monitoring. Once excavation is begun, the time to achieve beneficial results can be short relative to alternative technologies. Excavation and removal can be used in combination with almost any other remedial technologies.

The greatest problems with excavation, removal, and off-site disposal are associated with worker safety, short term impacts, cost, and institutional aspects. Where highly hazardous materials are present, excavation can pose a substantial risk to worker safety. Short term impacts such as fugitive dust emissions, toxic gases, and contaminated run-off are frequently a major concern, although mitigation measures can be taken. The

location of the nearest RCRA-approved landfill or incinerator is a very important consideration.

The excavation technologies include loading and casting excavation, hauling excavation, pumping and industrial vacuum loaders. The excavation technologies use equipment that is well known and demonstrated.

Pumping may be required in order to remove liquids and sludges from waste sites. The liquid wastes may be pumped to a treatment system or a tank truck for transport off-site. The selection of a pump is complicated by the presence of chemicals that could corrode or dissolve pump parts. Corrosive liquids having a low pH or a high chloride ion content can rapidly destroy most metal pumps. Wetted parts should be plastic, rubber, or ceramic, or if made of iron, should be alloyed with silicon and/or chromium. It is extremely important to check the chemical compatibility of seals with the fluid being pumped.

The presence of abrasive liquids also influences pump selection. Internal passages must have adequate dimensions or abrasive particles will damage parts that they rub against. Close internal clearances between stationary and moving parts is undesirable. Rubber and ceramic parts resist abrasive wear better than metal parts. Many manufacturers make abrasion-resistant models, and the pump should be selected after a detailed assessment of the waste to be pumped.

Industrial vacuum loaders such as the "Supersucker" can be used in large scale cleanup operations to remove soil or pools of liquid waste. Using industrial loaders for soil removal is safer and more efficient than using hand tools. The typical equipment consists of a vehicle mounted high-strength vacuums that can carry solids, liquids, metal and plastic scraps, and almost any

other material that can fit through the hose (i.e., 7 inch).

Because of the large capacity of the vacuum cylinder, vacuum trucks are generally not well suited volume to be removed less than the equivalent of 30 drums.

An important consideration with vacuum loaders is the compatibility of wastes with materials of construction. Vacuum cylinders can be purchased in carbon steel, stainless steel, aluminum, and nickel. They can be treated with a variety of coatings including epoxy, fiberglass, and neoprene rubber.

# <u>Disposal Technologies</u> (contaminated soil only)

This section describes the major factors to consider in the selection of an off-site or on-site disposal facility. Disposal technologies are landfilling and incineration. Landfilling of hazardous materials is becoming difficult and more expensive due to steadily growing regulatory control. Wastes that are amenable to treatment or incineration should be segregated from wastes for which no treatment alternative is known. Landfilling should usually be regarded as the least attractive alternative at a site cleanup.

#### o Off-site Disposal

Determining the feasibility of off-site disposal by landfilling, incineration or both requires knowledge of RCRA regulations (40 CFR Parts 261-265) and other regulations developed by states. RCRA manifest requirements must be complied with for all wastes that are shipped off-site. In addition, the waste generator must comply with RCRA manifest requirements. The generator should ensure that the facility selected to receive the wastes is in compliance with all applicable Federal and State regulations. RCRA storage and disposal facilities are required to notify the generator, in writing, that they are capable of

managing the wastes. The generator must keep a copy of this written notification on file as part of the operating record.

A detailed waste analysis is generally required before a waste is accepted by a treatment/disposal facility. On-site pretreatment of wastes may be required in order to make them acceptable for off-site transport or to meet the requirements of an incineration or disposal facility.

The transportation of wastes is regulated by the Department of Transportation (DOT), the EPA, the States, and in some instances local regulations. The EPA regulations under RCRA adopt DOT regulations pertaining to labeling, placarding, packaging, and spill reporting. Vehicles for off-site transport must be DOT approved and must display the proper DOT placard. Before a vehicle is allowed to leave the site, it should be rinsed or scrubbed.

o On-site Land Disposal
On-site disposal landfilling.

The on-site disposal of wastes by landfilling will require the design and construction of new landfills which comply substantially with RCRA landfill facility standards under 40 CFR Part 264. It should be noted that EPA guidance for CERCLA responses require most on-site disposal actions "to attain or exceed applicable and relevant standards of Federal public health and environmental laws, unless specific circumstances" dictate otherwise.

The RCRA requirements under 40 CFR Part 264 and all associated guidance are concerned with the proper location, design, construction, operation, and maintenance of hazardous waste management facilities. These requirements preclude

landfilling in areas of seismic instability, in a 100-year flood-plain, and where the integrity of the liner system would be adversely affected. These requirements also preclude landfilling of liquids and several types of highly mobile and/or highly toxic wastes. In addition to complying with these requirements, the evaluation of an on-site landfill program must address potential risks posed by the depth to groundwater at the site and the degree of naturally available groundwater protection if the liner system should fail. Other factors entering this evaluation include costs for monitoring the groundwater, collecting any accumulated leachate, and for implementing further corrective action if the groundwater has been contaminated by a leak from the new landfill.

The operating life of an on-site landfill should be minimized to avoid unnecessary generation of leachate caused by rainfall into an open cell. Sometimes it is more efficient to construct several landfill cells in sequence rather than to construct on large cell which will remain open for a long time period. All materials placed into a landfill should be compacted as much as possible using heavy equipment. This practice will minimize settling after closure. All equipment operators and workers must be thoroughly trained.

RCRA requires all land disposal facilities to establish a groundwater monitoring program. The program must be capable of determining the facility's impact on the quality of groundwater in the uppermost aquifer underlying the facility.

On-site landfilling is an expensive technology which should only be considered when: (1) there is so much waste to be disposed that the total cost of off-site waste management at an acceptable site is comparable; (2) simple capping of the site will not provide adequate protection of human health and the

environment; and (3) on-site conditions will allow the construction of a landfill that will protect human health and the environment. Since it is rare that all three of the above conditions are met at a site, the on-site landfill option is not frequently used.

# Migration Control

Technologies that will eliminate, reduce or modify the migration of the liquid plume or vapors in the ground or fugitive dust at the surface.

Containment and Diversion Technologies (of migration)

Surface water controls include a wide range of containment, diversion and collection methods which are designed to minimize contamination of surface waters, prevent surface water infiltration, and prevent off-side transport of surface waters which have been contaminated. The commonly employed technologies are capping, floating Covers, grading, revegetation, and surface water diversion/collection. The most effective strategy for managing surface flow frequently includes a combination of several of these water control technologies.

### o Capping

Capping is a process used to cover buried waste materials to prevent their contact with the land surface and groundwater. The designs of modern caps usually conform to the performance standards in 40 CFR 264.310, which addresses RCRA landfill closure requirements. These standards include minimum liquid migration through the wastes, low cover maintenance requirements, efficient site drainage, high resistance to damage by settling or subsidence, and a permeability lower than or equal to the underlying liner system or natural soils. These performance standards may not always be appropriate, particularly in

instances where the cap is intended to be temporary, where there is very low precipitation, and when the capped waste is not leached by infiltrating rainwater.

There are a variety of cap designs and capping materials available. Most cap designs are multi-layered to conform with design standards, however, single-layered designs are also used for special purposes. The selection of capping materials land a cap design is influenced by specific factors such as local availability and costs of cover materials, desired functions of cover materials, the nature of the wastes being covered, local climate and hydrogeology, and projected future use of the site in question.

Capping is necessary whenever contaminated materials are to be buried or left in place at a site. In general, capping is performed when extensive subsurface contamination at a site precludes excavation and removal of wastes. Capping is performed together with the groundwater extraction or containment technologies to prevent or significantly reduce further plume development. Ground waster monitoring wells are often use in conjunction with caps to detect any unexpected migration off the capped wastes. A gas collection system should always be incorporated into a cap when wastes may generate gases. Capping is also associated with surface waster control technologies such as ditches, dikes and berms because these structures are often designed to accept rainwater drainage from the cap. Grading and revegetation are incorporated into multi-layered caps.

Caps need long-term maintenance and have uncertain design lives. Caps will need to be periodically inspected for settlement, ponding of liquids, erosion, and naturally occurring invasion by deep-rooted vegetation. Groundwater monitoring wells

associated with caps need to be periodically sampled and maintained.

Caps generally have a minimum design life of 20 years when a synthetic liner is the only liquid barrier. This period may extend to over one hundred years when a synthetic liner is supported by a low-permeability base; the underlying wastes are unsaturated; there is great distance between the waste and the groundwater table; and proper maintenance procedures are observed.

Multi-layered caps generally conform to EPA's guidance under RCRA which recommends a Three-layered system consisting of an upper vegetative layer, underlain by a drainage layer over a low permeability layer. The vegetative layer is served by the topsoil layer; the drainage layer can be composed of sand; and the low permeability layer can be formed by a combined synthetic and soil liner system. The cap functions by diverting infiltrating liquids from the vegetative layer through the drainage layer and away from the underlying waste materials.

The low permeability layer of the multi-layered cap can be composed of natural soils, admixed soils, a synthetic liner overlying at least 2 feet of low permeability natural soil or soil admix is recommended because the synthetic liner allows virtually no liquid penetration for a minimum of 20 years, while the soil layer provides assurance of continued protection even if the synthetic liner fails.

Standard design practices specify permeabilities of less than 1- E-7 cn/sec for the soil liner. This specification could be met with a natural soil or blending of different on-site soils. Chemical stabilizers, cements, lime, ash, furnace slag or other materials may be added to soil to modify its properties.

Flexible synthetic membranes are made of polyvinyl chloride, chlorinated polyethylene, ethylene propylene rubber, butyl rubber, Hypalon and neoprene, and elasticized polyolefin can be used as liners. Synthetic liners are generally more expensive and involve labor-intensive sealing materials that require special field installation methods.

Single-layered caps can be constructed of any of the low permeability materials mentioned previously. Natural soil and admixes are not recommended because they are disrupted by freeze/thaw cycles and exposure to drying causes them to shrink and crack. The most effective single layer caps are composed of concrete and/or bituminous asphalt.

Capping is a reliable technology for sealing off contamination from the aboveground environment and significantly reducing underground migration of wastes. Caps can be constructed over virtually any site, and can be completed relatively quickly if the ground is not frozen or saturated. Most of the soil materials for capping are readily available in most areas of the country, and the synthetic materials are widely manufactured and distributed. The equipment used for implementing this technology is mostly standard road construction equipment, however some specialized testing equipment must be supplied by the liner installer or a soil testing company.

The performance of a properly installed, multi-layered cap is generally excellent for the first 20 years of service. However, after this time period the integrity of the synthetic liner becomes uncertain and should be investigated regularly. Unforseen settling invasions by burrowing animals and deep-rooted plants can contribute to the need for periodic monitoring and maintenance of the cap. Groundwater monitoring wells, often

associated wit caps, need to be sampled periodically and maintained.

# o floating Covers

Floating covers are mentioned to insure that all potential technologies are considered. This technology is not discussed in detail because the sources for which it is appropriate are not present. Floating cover consist of a synthetic lining placed in one piece over an impoundment, with proper anchoring at the edges, and with floats to prevent the lining from submerging. This technology is used mainly to cover drinking water supply reservoirs, but it can be used temporarily to prevent overtopping a waste lagoon.

# o Grading

Grading is the general term for techniques use to reshape the surface of covered landfills in order to manage surface water infiltration and run-off while controlling erosion. The spreading and compaction steps used in grading are techniques practiced routinely at sanitary landfills. The equipment and methods used in grading are essentially the same for all landfill surfaces, but applications of grading technology will vary by site. Grading is often performed in conjunction with surface sealing practices and revegetation as part of an integrated closure plan.

The techniques and equipment used in grading operations are well established and are widely used in all forms of land development. It is usually possible to find contractors and equipment locally, thus expediting the work and avoiding extra expenses.

Surface grading serves to (1) reduce ponding which minimizes infiltration and reduces subsequent differential settling, (2)

reduces runoff velocities to reduce soil erosion, (3) roughens and loosens soils in preparation for revegetation and (4) can be a factor in reducing or limiting leaching of wastes.

There are potential difficulties associated with grading. Large quantities of a difficult to obtain cover soil may be required to modify existing slopes. Periodic regrading and future site maintenance may be necessary to eliminate depressions formed through differential settlement and compaction, or to repair slopes that have slumped or become badly eroded.

# o Revegetation

Revegetation is the establishment of a vegetative cover as a method to stabilize the surface of a disposal site. This technique is often preceded by capping and grading. Revegetation decreases erosion by wind and water and contributes to the development of a naturally fertile and stable surface environment. Revegetation includes (1) selection of plant species, (2) seedbed preparation, (3) seeding/planting, (4) mulching and/or chemical stabilization, and (5) fertilization and maintenance.

There are potential problems implementing a revegetation program. Clays or synthetic barriers below support topsoil in poorly drained areas may cause swamping of cover soil and subsequent anaerobic conditions. A cover soil which is too thin may dry excessively in arid seasons and irrigation may be necessary. Improperly vented gases and soluble phytotoxic contaminants may kill or damage vegetation. The roots of shrubs or trees may penetrate the waste cover and cause water infiltration and gas exfiltration. Periodic maintenance of revegetated areas may include liming, fertilizing, mowing and/or replanting.

A well-designed and properly implemented revegetation plan will effectively reduce erosion and stabilize the surface of a covered disposal site, thereby improving the effectiveness and reliability of the cap. A multi-layered capping system and properly graded slopes, in combination with suitable vegetative cover, will eventually isolate buried wastes from surface hydrologic input.

Although vegetative covers requires frequent maintenance, it actually prevents more costly maintenance which would result form erosion by surface soils. Revegetation is also essential to the integrity and performance of dikes, waterways, and sedimentation basins.

# o Surface Water Diversion and Collection

Surface water diversion and collection technologies include dikes, berms, channels, waterways, terraces, benches, chutes, downpipes, seepage basins, ditches, sedimentation basins and ponds, levees and floodwalls. All these technologies are well-established. Many of these are intended for short-term use and are neither effective nor reliable for use as a long-term remedial measure.

Dikes and berms are well-compacted earthen ridges or ledges constructed immediately upslope from or along the perimeter of disturbed areas. These structures are generally designed to provide short-term protection of critical areas by intercepting storm run-off and diverting the flow to natural or manmade drainage ways, to stabilized outlets, or to sediment traps.

Dikes and berms ideally are constructed of erosionresistant, low permeability, clay soils. The general design life of these structures is on the order of lone year maximum; seeding and mulching or chemical stabilization of dikes and berms may extend their life expectancy.

Channels are excavated ditches. Diversion channels are used primarily to intercept run-off or reduce slope length. They may be stabilized with vegetation or stone rip-rap.

Failure of channels and waterways may result from insufficient capacity, excessive velocity, or inadequate vegetative cover. Grassed waterways must be periodically mowed to prevent excessive retardation of flow and subsequent ponding of water. Vegetated channels may also require periodic sodding, remulching, and fertilizing. Sediment accumulation often results in failure of channels and waterways. Control of vegetation to prevent matted growth and high allowable design velocities will reduce sediment accumulation. Stone channels have the advantage of requiring minimum maintenance.

Terraces and benches are embankments constructed along the contour of very long or very steep slopes to intercept and divert flow and to control erosion by reducing slope length. These structures are classified as bench terraces or drainage benches. Bench terraces are used primarily to reduce land slope while drainage benches on broadbased terraces act to remove or retain water on sloping land.

Chutes and downpipes are structures used to carry concentrated flows of surface run-off from one level to a lower level without erosive damage. They generally extend downslope from earthen embankments and convey water to stabilized outlets located at the base of terraced slopes. Chutes are open channels, normally lined with bituminous concrete, portland cement concrete, grouted rip-rap, or similar non-erodible material. Downpipes are temporary structures constructed of

rigid piping or flexible tubing of heavy-duty fabric.

Chutes and downpipes often represent key elements in combined surface control systems. They are especially effective in preventing erosion on long, steep slopes, and can be used to channel storm run-off to sediment traps, drainage basins, or stabilized waterways for off-site transport. However, they provide only temporary erosion control while slopes are stabilized with vegetative growth.

Seepage basins and ditches are used to discharge water to groundwater. They may also be used in in-situ treatment to force reagents into the subsurface. Seepage basins and ditches are most effective in highly permeable soils so that recharge can be performed. They are not applicable at sites where collected runoff or groundwater is contaminated. Many basins and ditches are used in areas with shallow groundwater tables. Very deep basins or trenches can be hazardous. Seepage ditches distribute water over a larger area than achievable with basins. They can be used for all soil where permeability exceeds about 0.9 inches per day. It is unlikely that this technology would be appropriate for the INEL site because of the deep groundwater table and uncertainties associated with the vertical flow of liquids.

Sedimentation basins are used to control suspended solids entrained in surface flows. A sedimentation basin is constructed by placing an earthen dam across a water or natural depression, or y excavation, or by a combination of both. The purpose of installing a sedimentation basin is to impede surface run-off carrying solids, thus allowing sufficient time for the particulate mater to settle. Sedimentation basins are usually the final step in control of diverted, uncontaminated, surface run-off, prior to discharge. They are especially useful in areas

where there exists a high silt or sand content in the surface run-off.

Levees are earthen embankments that function as flood protection structures in areas subject to inundation from tidal flow or riverine flooding. Levees create a barrier to confine floodwaters to a floodway and to protect structures behind the barrier. Floodwalls perform much the same function as levees, but are constructed of concrete. For hazardous waste sites, levees and floodwalls help to control major losses of waste and cover material and prevent massive leachate production and subsequent contamination from riverine or tidal flooding.

Flood containment levees are most suitable for installation in flood fringe areas or areas subject to storm tide flooding, but not for areas directly within open floodways. Because of the relatively long, flat side slopes of levees, an embankment of any considerable height requires a very large base width. For locations with limited space and fill material, or excessive real estate costs, the use of concrete floodwalls is preferred as an alternative to levee construction.

Levees are generally constructed of compacted impervious fill. Special drainage structures are often required to drain the area behind the embankment. Ideal construction of levees is with erosion-resistant low permeability soils, preferably clay. Most levees are homogeneous embankments; but if impermeable fill is lacking, or if seepage through and below the levee is a problem, then construction of a compacted impervious core or sheet-pile cut-off extending below the levee to bedrock may be necessary.

All the diversion and containment methods described require frequent inspection, maintenance, performance checks to ensure

continuous reliability. Operation and maintenance requirements for these measures are relatively simple. However, failure of such surface control measures as floodwalls can be costly.

### **Groundwater Control**

Control of contamination in the groundwater involves one of four options: (1) containment of a plume; (2) removal of a plume after measures have been taken to halt the source of contamination; (3) diversion of groundwaters to prevent clean groundwater from contacting a drinking water supply; or (4) prevention of leachate formation by lowering the water table beneath a source of contamination. Remedial technologies for controlling groundwater contamination problems are generally placed in one of four categories: (1) groundwater pumping, involving extraction of water from or injection of water into wells to capture a plume or alter the direction of groundwater movement; (2) subsurface drains, consisting of gravity collection systems designed to intercept groundwater; (3) low permeability barriers, consisting of a vertical wall of low permeability materials constructed underground to divert groundwater flow or minimize leachate generation and plume movement; or (4) in-situ treatment methods to biologically or chemically remove or attenuate contaminants in the subsurface. These technologies can be used singularly or in combination to control groundwater contamination. This section describes these technologies. 600 foot depth to the groundwater table and the overlying basalt layers would make the implementation of some groundwater controls such a drains and barriers difficult, cost prohibitive and probably technically infeasible. However, they are presented in this section with limited detail to insure that all technologies are considered.

# o Groundwater Pumping

Groundwater pumping techniques involve the active manipulation and management of groundwater in order to contain or remove a plume or to adjust groundwater levels in order to prevent formation of a plume. Types of wells used in management of contaminated groundwater include wellpoints, suction wells, ejector wells, and deep wells. The selection of the appropriate well type depends upon the depth of contamination and the hydrologic and geologic characteristics of the aquifer.

Pumping is most effective at sites where underlying aquifers have high intergranular hydraulic conductivity. It has been used with some effectiveness at sites with moderate hydraulic conductivities and where pollutant movement is occurring along fractured or jointed bedrock. In fractured bedrock, the fracture patterns must be traced in detail to ensure proper well placement.

Where plume containment or removal is the objective, either extraction wells or a combination of extraction and injection wells can be used. Use of extraction wells alone is best suited to situations where contaminants are miscible and move readily with water; where the hydraulic gradient is steep and hydraulic conductivity high; and where quick removal is not necessary. Extraction wells are frequently used in combination with slurry walls to prevent groundwater from overtopping the wall and to minimize contact of the leachate with the wall in order to prevent wall degradation.

A combination of extraction and injection wells is frequently used in containment or removal where the hydraulic gradient is relatively flat and hydraulic conductivities are only moderate. The function of the injection well is to direct contaminants to the extraction wells. This method has been used

with some success for plumes which are not miscible with water. One problem with such an arrangement of wells is that, dead spots can occur when these configurations are between adjacent radii of influence. Another disadvantage is that injection wells can suffer from many operational problems, including air locks and the need for frequent maintenance.

Ground water barriers can be created using injection wells to change both the direction of a plume and the speed of plume migration. By crating an area with a higher hydraulic head, the plume can be forced to change direction. This technique may be desirable when short-term diversions are needed or when diversion will provide the plume with sufficient time to naturally degrade so that containment and removal is not required.

Wellpoint systems are effective in almost any hydraulic situation. They are best suited for shallow aquifers where extraction is not needed below more than about 22 feet. Beyond this depth, suction lifting is ineffective. Suction wells operate in a similar fashion to wellpoints and are also depth limited. The only advantage of suction wells over wellpoints is that they have higher capacities. For extraction depths greater than 20 feet, deep wells and ejector wells are use. Deep well systems are better suited to homogeneous aquifers with high hydraulic conductivities and where large volumes of water may be pumped. Ejector wells perform better than deep wells in heterogeneous aquifers with low hydraulic conductivities. A problem with ejector systems is that they are inefficient and are sensitive to constituents in the groundwater which may cause chemical precipitates and well clogging.

Ground water pumping systems are the most versatile and flexible of the groundwater control technologies. When used together with a barrier wall and cap, complete hydrologic

isolation of a site can be achieved. Groundwater pumping systems, however, perform poorly in low transmissivity aquifers.

Operational flexibility is high since pumping rates can be modified to adjust to changes in flow rate. System performance is generally good provided the wells are properly designed and maintained. Deadspots and areas where cones of depression overlap should be continuously monitored to ensure effectiveness. The reliability of pumping systems can be adversely affected by mechanical and electrical failure of pumps which can result in loss of contaminants. However, repairs and replacement of parts can be done quickly and easily.

Well systems are generally safer to install then drains and barrier walls since there is no need for trench excavation. Installation is relatively easy and quick. Contractors qualified to drill and install wells are readily available.

# o Subsurface drains

Subsurface drains include any type of buried conduit used to convey and collect aqueous discharges by gravity flow. Subsurface drains essentially function like an infinite line of extraction wells. They create a continuous zone of influence in which groundwater within this zone flows towards the drain.

Drains essentially function like an infinite line of extraction wells, they can perform many of the same functions as wells. They can be used to contain or remove a plume, or to lower the groundwater table to prevent contact of water with the waste material. The decision to use drains or pumping is generally based on cost-effectiveness.

For shallow contamination problems, drains can be more costeffective than pumping, particularly in strata with low or variable hydraulic conductivity. Under these conditions, it would be difficult to design and it would be cost prohibitive to operate a pumping system to maintain a continuous hydraulic boundary. Subsurface drains may also be preferred over pumping where groundwater removal is required over a period of several years, because the operation and maintenance cost associated with pumping are substantially higher.

Subsurface drains are generally limited to shallow depth. Although it is technically feasible to excavate a trench to almost any depth, the costs of shoring, dewatering, and hardrock excavation can make drains cost prohibitive at depths of less than 40 feet. However, in stable low permeability soils where little or no rock excavation is required, draining may be cost-effective to depths of 100 feet. Other limitations to the use of this technology include the presence of viscous or reactive chemicals which could clog drains and envelope material. Conditions which favor the formation of iron manganese or calcium carbonate deposits may also limit the use of drains.

Relative to pumping, subsurface drains can be difficult and costly to install particularly where extensive hard rock excavation and dewatering is required. They are also time consuming to install and may not be an appropriate alternative where immediate remediation is required. Safety of field workers is also more of a concern with subsurface drains because of the need for extensive trench excavation.

Drains are generally more cost-effective than pumping in areas with low hydraulic conductivity particularly where pumping would be required for an extended period of time. They are easier to operate since water is collected by gravity flow. They are also more reliable from the standpoint that there are no electrical components which can fail. However, when drains fail

due to clogging, breaks in the pipes, or sinkhole formation, they can be costly and time consuming to rehabilitate.

#### o Subsurface Barriers

Subsurface barriers are a variety of methods whereby low permeability cut-off walls or diversions are installed below ground to contain, capture, or redirect groundwater flow in the vicinity of a site. The most commonly use subsurface barriers are slurry walls, particularly soil-bentonite slurry walls. Less common are cement-bentonite or concrete (diaphragm) slurry walls, grouted barriers, and sheet piling cut-offs. Grouting may also be used to crate horizontal barriers for sealing the bottom of contaminating sites.

Slurry walls are the most common subsurface barriers because they are a relatively inexpensive means of vastly reducing groundwater flow in unconsolidated earth materials. slurry wall can be applied to a variety of barriers all having one thing in common; they are all constructed in a vertical trench that is excavated under a slurry. This slurry, usually a mixture of bentonite and water, acts essentially like a drilling fluid. It hydraulically shores the trench to prevent collapse, and, at the same time, forms a filter cake on the trench walls to prevent high fluid losses into the surrounding grounds. wall types are differentiated by the materials used to backfill the slurry trench. Most commonly, an engineered soil mixture used to backfill the slurry trench. Typically, and engineered soil mixture is blended with the bentonite slurry and placed in the trench to form a soil-bentonite slurry wall. In some cases, the trench is excavated under la slurry or portland cement, bentonite, and water, and this mixture is left in the trench to harden into a cement-bentonite slurry wall. In the rare case where great strength is required, pre-cast or cast-in-place

concrete panels are constructed in the trench to form a diaphragm wall.

Soil-bentonite slurry walls are backfilled with soil materials mixed with a bentonite and water slurry. Of the three major types of slurry walls, soil-bentonite walls offer the lowest installation costs, the widest range of chemical compatibilities, and the lowest permeabilities. At the same time, soil-bentonite walls have the least strength and require a large work area, and, because the slurry and backfill can flow, are applicable only to sites that can be graded to nearly level. A major concern in the application of soil-bentonite walls to site remediation is the compatibility of the backfill mixture with site contaminants. Evidence indicates that soil-bentonite backfills are not able to withstand attack by strong acids and bases, strong salt solutions, and some organic chemicals. For contaminate migration control there is a lack of long-term performance data. Soil bentonite walls have been used for decades for groundwater control in conjunction with large dam projects and there is ample evidence of their success in this application. The ability to withstand long-term permeation by many contaminants is in question.

Cement-bentonite slurry walls share many characteristics with soil-bentonite slurry walls. The principal difference between the two is the backfill. They are generally excavated using a slurry of Portland cement, bentonite, and water. This slurry is left in the trench and allowed to set up to form the completed barrier.

Cement-bentonite walls are more versatile than soilbentonite in two ways. First, because the slurry sets up into a semirigid solid, this type of wall can accommodate variations in topography by allowing one section to set while continuing the next section at a different elevation. Second, because the excavation slurry is commonly the backfill too, this type of wall is better suited to restricted areas where there is no room to mix soil-bentonite backfill. Cement-bentonite is stranger than soil-bentonite and so is used where the wall must have less elasticity, such as adjacent to a building or roads.

Cement-bentonite slurry walls are limited in their use by their higher costs, somewhat higher permeability, and their narrower range of chemical compatibilities. Cement-bentonite is susceptible to attack by sulfates, strong acids and bases, and other highly ionic substances.

Diaphragm walls are barriers composed of reinforced concrete panels, which are emplaced by slurry trenching techniques. They may be cast-in-place or precast, and are capable of supporting great loads. This degree of strength is seldom if ever called for at a waste site. This technology has the same limitations as cement-bentonite slurry walls.

Grout curtains are subsurface barriers created in unconsolidated materials by pressure injection. Grout barriers can be many times more costly as slurry walls and are generally incapable of attaining truly low permeabilities in unconsolidated materials. A recent field test study of two chemical grouts revealed significant problems in forming a continuous grout barrier due to non-coalescence of grout pods in adjacent holes and grout shrinkage. This study concludes that conventional injection grouting is incapable of forming a reliable barrier in medium sands. Grout curtains, while requiring no operation and little or no maintenance may require more monitoring than other barriers. This is because if even a very small gap is left in the barrier, it can enlarge quite rapidly by piping or tunneling if there is a sufficient hydraulic gradient across the wall.

Sheet Piling can be used to form a groundwater barrier. Sheet piles can be made of wood, pre-cast concrete, or steel. Wood is an ineffective water barrier, however, and concrete is used primarily where great strength is required. Steel is the most effective in terms of groundwater cut-off and cost. Steel is ineffective in rocky soils because damage or deflection of the piles is likely to render the wall ineffective.

The performance life of sheet piling wall can be between 7 and 40 years, depending on the condition of the soil in which the wall is installed. Sheet piling walls have been installed in various type of soils ranging from well-drained sand to imperious clay.

o In-situ Treatment See earlier discussion on in-situ waste treatment.

# Fugitive Dust Controls

Fugitive dust is particulate matter that becomes airborne due to the forces of wind, man's activity, or both. It may include windblown particulate matter from paved or unpaved roads, exposed land surface and/or material made airborne by vehicular movement. Commonly used techniques for controlling fugitive dusts from waste sites include the use of chemical dust suppressants, wind screens, water sprays and other measures. These are all techniques tat are proven and have been used widely.

#### o Dust Suppressant

Dust suppressants include a wide range of natural and synthetic waste materials which strengthen bonds between soil particles and hold this strengthened condition for an appreciable period of time. A wide variety of resins, bituminous materials and polymers are marketed as dust suppressants. Chemical dust suppressants are most commonly applied with water wagons equipped

with muzzles that shoot a flat spray behind the vehicle. The effectiveness of a dust suppressant is dependent upon maintaining the soil-chemical crust. Emerging weeds and any type of disturbance from traffic will break this crust. This technology is an effective temporary control measure. It must be reapplied to provide long-term fugitive dust control. Application is straightforward and can be accomplished quickly. There is a potential for secondary impacts from the use of certain chemical dust suppressants which contain toxic substances.

# o Wind Fences/Screens

A wind fence is a porous screen which takes up or deflects a sufficient amount of wind so that the wind velocity is lowered below the threshold required for initiation of soil movement. Wind screens are typically 4 to 10 feet high and are composed of polyester or other high strength material. This technology is only 60 percent efficient in controlling inhalable particulate at wind speeds of 10 to 13 mph. Studies have shown no consistent benefits from windscreens for particles in the respirable size range. Maximum reduction of wind velocity can be expected for a distance of 1 to 5 fence heights down stream.

### o Water sprays

Water spray is the most common means of dust control. It simply involves spraying water on the exposed surface areas. This method is mainly used to reduce fugitive dusts along active travel paths, excavation areas and from tuck boxes loaded with soils. Active travel areas dry quickly and water must be reapplied frequently (about every 2 hours) to maintain effectiveness.

### o Other measures

Other measures for paved roads include sweeping, vacuuming or flushing. These methods are not effective with fine

particles. Dust from excavation activities can be reduced by maintaining a favorable slop and orientation on the waste or overburdened piles. Piles can also be covered and an auger feed system can be installed to emplace and remove material.

### Gaseous Emissions Controls

Gases may be emitted by the vaporization of liquids, venting or entrained gases or by chemical and biological reactions with solid and liquid waste material. Volatile organics may be released slowly but continuously form surface impoundments or landfills. Methods for controlling the release of gaseous emissions to the atmosphere include covers for control of volatile emissions from impoundments and active gas collection systems for collection and control of gases generated in landfills.

#### o Covers

Covers involve the placement of a barrier at the water-air interface to reduce gaseous emissions. Lagoon covers, floating immiscible liquids and floating spheres can all be use for this purpose. There are no sources at the INEL site for which this remedial technology is appropriate. Therefore it is not presented in more detail.

### o Passive Perimeter Gas Control Systems

Passive perimeter gas control systems control gas movement by altering the paths of flow without the use of mechanical components. Passive systems may be further categorized as highpermeability or low permeability.

High-permeability systems entail the installation of highly permeable trenches or wells between the landfill and the area to be protected. Since the permeable material offers conditions

more conducive to gas slow than the surrounding soil, paths of flow to points of controlled release are established. High-permeability systems generally take the form of trenches or wells excavated outside of the landfill limit and backfilled with a highly permeable medium such as a course crushed stone.

Low-permeability systems effectively block gas flow into areas of concern by the use of barriers (i.e., synthetic membranes of clays) between the landfill and the area to be protected. With low-permeability systems, gases are not collected and therefore cannot be conveyed to a point of controlled release or treatment. The purpose of the system is to prevent or reduce gas migration into areas that are to be protected. These two concepts of passive gas control are often combined in the same system to provide controlled venting of gasses and blockage of available paths for gas migration.

Passive gas control systems can be used at virtually any site where there is capability to trench or drill and excavation to at least the same depth at the landfill. limiting factors could include the presence of a perched water table or rock strata. Passive vents would generally be expected to be less effective in areas of high rainfall or prolonged freezing The depth of the trench is dictated by local site temperatures. In general, the trench should extend from the conditions. ground surface to a relatively impermeable stratum of unfractured bedrock or clay or to the lowest groundwater table level. some applications, the trench need not be as deep, so long as it extends to sufficient depth to intercept all possible avenues of gas migration. This depth is a function of the landfill depth and the geology in the vicinity of the landfill. The logistics of excavation open trenches can constrain the use of [passive] venting trenches to relatively shallow depths of 30 feet and less.

Passive gas control systems are essentially self-operating. Vent pipes, drainage patterns and general conditions in the vicinity of the systems should be occasionally inspected to identify the need for repairs or other maintenance. Monitoring the effectiveness of passive gas control systems normally consists of periodic sampling of subsurface gases from probes installed in the area being protected.

High permeability gas control systems have functioned adequately in mainly applications; however, there appear to be no clear patterns which dictate success or failure of the systems. While passive vents may perform effectively at some sites, the method cannot be considered to be reliable for gas migration control because of the inability of vents to control diffuse flow. Numerous passive well venting systems have been converted to active systems because of poor or unreliable performance. Low-permeability systems block diffuse flow and are highly reliable when properly designed and installed. Passive gas control systems can be implemented with relatively conventional construction equipment, labor, and materials. Handling and placement of synthetic liners requires specialized equipment and labor.

# o Active Perimeter Gas Control Systems

Active perimeter gas control systems alter pressure gradients and paths of gas movement by mechanical means. These systems normally consist of (1) gas extraction wells, (2) gas collection headers and (3) vacuum blowers or compressors. In a typical system centrifugal blowers create vacuum through the collection headers and wells to the wastes and ground surrounding the wells. A pressure gradient is thereby established, inducing flow from the landfill to the blower. Subsurface gases flow in the direction of decreasing pressure gradient and are released

directly to the atmosphere, treated and released, or, in some cases, recovered.

Active perimeter gas control systems can be used at virtually any site where there is capability to drill an excavation through landfilled material to the required depth. Limiting factors could include the presence of free-standing leachate or impenetrable materials within the landfill. Active systems are not sensitive to the freezing or saturation of surface or cover soils.

Gas extraction wells maybe installed either in refuse fill or in soil outside of the limit of fill. Wells normally consist of a drilled excavation 12 to 36 inches in diameter which is backfilled with one inch or larger crushed stone and 2- to 6-inch piping, which is perforated in the areas where gas is to be collected and solid in the upper portions. Solid-wall pipe is used and a concrete or clay seal is provided in the upper portion of the well to minimize infiltration of atmospheric air into the system. A valve is provided on the lateral connection of each well to allow regulation of flow and balancing of systems consisting of multiple wells. A monitoring port is provided for measuring velocity, pressure, and gas composition. Well spacing is a critical factor in the design of the system. Spacings on the order of 100 feet are commonly used, however, the appropriate spacing for a given site will depend upon the depth of the landfill, the magnitude of the vacuum applied to the well, and the rate of gas withdrawal.

Active gas control systems require testing and adjustment throughout their lives of operation. Initial start-up testing is required to ensure that all components are functioning as intended. Throttling of individual well valves and blower

control valves is required to balance the system. Mechanical components require regular service such a lubrication and part replacement. In addition, subsurface gas probes in the area being afforded protection should be monitored at least annually after system start-up to ensure that gas migration is being controlled.

Differential settlement of the landfill material beneath header pipes can cause pipe movements resultant in adverse slopes, accumulation of condensate in low spots, and partial or complete blockage of gas flow. Proper pipe slopes an condensate drains can minimize this problem. A regular program of periodic inspection and maintenance should be established to identify pipe breakage, condensate blockage, or other header system failure.

# o Active Interior Gas Collection/Recovery System

Active interior gas collection systems are similar to active perimeter systems except gas extraction wells are placed over the entire landfill surface. The design limitations and considerations are the same as perimeter systems except that spacing of wells is generally grater. Spacings of 200 feet are common. This technology has been applied or is under development for methane at over 50 sites worldwide.

# Treatment Technologies

This section describes treatment methods applicable for treating aqueous, gaseous, and solid waste streams. Many of the methods described are widely used in industrial waste treatment applications and are well described in the literature.

# o Aqueous Waste (pumped liquids)

Because of their potential diversity there are many treatment technologies that can be applied to aqueous waste

streams. Rarely will any one treatment be sufficient so these techniques are usually used in combination. The most applicable treatment processes are (1) activated carbon treatment, (2) biological treatment, (3) filtration, (4) precipitation/ flocculation, (5) sedimentation technology, (6) ion exchange and sorptive resins, (7) reverse osmosis, (8) neutralization, (9) gravity separation, (10 air stripping, (11) oxidation, and (12) chemical reduction.

Activated carbon treatment is the process of adsorption onto activated carbon. It involves contacting a stream with the carbon, usually by flow through a series of packed bed reactors. The activated carbon selectively adsorbs constituents by a surface attraction phenomenon in which organic molecules are attracted to the internal pores of the carbon granules. Once the micropore surfaces are saturated with organics, the carbon is "spent" and must be either replaced or thermally regenerated. The time to reach "breakthrough" or exhaustion is the single most critical operating parameter.

Activated carbon is a well developed technology. It is especially well suited for removal of mixed organics from aqueous wastes. It is an effective and reliable means of removing low solubility organics. It is suitable for treating a wide range of organics over a broad concentration range.

Activated carbon is easily implemented into more complex treatment systems. The process is well suited to mobile treatment systems as well as on-site construction. Space requirements are small, start-up and shut-down are rapid, and there are numerous contractors who are experienced in operating mobile units.

The most obvious maintenance consideration associated with activated carbon treatment is the regeneration of spent carbon for reuse. Regeneration must be performed for each column at the conclusion of its bed-like so the spent carbon may be restored as close as possible to its original condition for reuse; otherwise, the carbon must be disposed.

Biological Treatment removes organic matter from the waste stream through microbial degradation. The most prevalent form of biological treatment is aerobic (i.e., requires oxygen). Specific processes that may be applicable include conventional activated sludge, pure oxygen activated sludge, extended aeration, contact stabilization, fixed film systems which include rotating biological discs and trickling filters.

There is considerable flexibility in biological treatment because of the variety of available processes and adaptability of the microorganisms themselves. Many organic chemical are considered biodegradable, although the relative ease of biodegradation varies widely.

Biological treatment has not been widely used in hazardous waste site remediation. Although the process can effectively treat a wide range of organics, it has several drawbacks for waste site application. The reliability of the process can be adversely affected by "shock" loads of toxics. Start-up time can be slow if the organisms need to be acclimated to the wastes and the detention time can be long for complex wastes. However, the existence of cultures which have been previously adapted to hazardous wastes an dramatically decrease start-up and detention time.

Loss of volatile organics from biological treatment processes can pose some localized air pollution and a health

hazard to field personnel. Sludge produced in biological waste treatment may be a hazardous waste itself due to the sorption and concentration of toxic and hazardous compounds contained in the wastewater.

Filtration is a physical process whereby suspended solids are removed from solution by forcing the fluid through a porous Granular media filtration is typically used for treating aqueous waste streams. The filter media consists of a bed of granular particles. The bed is contained within a basin and is supported by an underdrain system which allows the filtered liquid to be drawn off while retaining the filter media in place. As water laden with suspended solids passes through the bed of filter medium, the particles become trapped on top of and within the bed. In order to prevent plugging, the filter is backflushed at high velocity to dislodge the particles. The backwash water contains high concentrations of solids and requires further treatment.

Filtration is a reliable and effective means of removing low levels of solids for streams provided the content does not vary greatly and the filter is backwashed at appropriate intervals. Filtration equipment is relatively simple, readily available in a wide range of sizes and easy to operate and control. The significant maintenance consideration is handling the backwash. Backwash will generally contain high concentrations of contaminants and require subsequent treatment.

Precipitation is a physicochemical process whereby some or all of a substance in solution is transformed into a solid phase. It is based on alteration of the chemical equilibrium relationships affecting the solubility of inorganic species. Removal of metals as hydroxides or sulfides is the most common precipitation application in wastewater treatment. Generally,

lime or sodium sulfide is added to the wastewater in a rapid mixing tank along with flocculating agents. The wastewater flows to a flocculation chamber in which adequate mixing and retention time is provide for agglomeration of precipitate particles. Agglomerated particles are separated from the liquid phase by settling in a sedimentation chamber, and/or by other physical processes such as filtration.

Flocculation is used to describe the process by which small, unsettleable particles suspended in a liquid medium are made to agglomerate into larger, more settleable particles. Chemicals used to cause flocculation include alum, lime, various iron salts, and organic flocculating agents called polyelectrolytes.

Once suspended particles have flocculated into larger particles, they usually an be removed from the liquid by sedimentation, provided that a sufficient density difference exists between the suspended matter and the liquid.

Precipitation is applicable to the removal of most metals from aqueous streams including zinc, cadmium, chromium, copper, fluoride, lead, manganese, and mercury. Also certain anionic species can be removed by precipitation, such as phosphate, sulfate, and fluoride.

Certain physical or chemical characteristics may limit the applicability of precipitation. Organic compounds may form organometallic complexes with metals, which could inhibit precipitation. Cyanide and other ions in the stream may also complex with metals, making treatment by precipitation less efficient. Highly viscous waste streams will inhibit settling of solids.

Precipitation and flocculation are well established technologies and the operating parameters are well defined. The processes require only chemical pumps, metering devices, and mixing and settling tanks. The equipment is readily available and easy to operate. Precipitation is nonselective in that compounds other than those targeted may be removed. Both precipitation and flocculation are nondestructive and generates a large volume of sludge which must be disposed.

Sedimentation is a process that relies upon gravity to remove suspended solids in an aqueous waste stream. The proces consists of a basin that will maintain the liquid in the quiescent state, a means of directing the liquid to the basin in a manner conducive to settling, and a means of physically removing the settled particles. This technology is applicable to the removal of particles heavier than water. Sedimentation provides a reliable means to remove suspended matter and is capable of 90 to 99 percent efficiency.

Ion Exchange is a process whereby the toxic ions are removed from the aqueous phase by being exchanged with relatively harmless ions held by the ion exchange material. Modern ion exchange resins are primarily synthetic organic materials containing ionic functional groups to which exchangeable ions are attached. These synthetic resins are structurally stable, exhibit a high exchange capacity, and can be tailored to show selectivity towards specific ions. The exchange reaction is reversible and concentration dependent, and it is possible to regenerate the exchange resins for reuse. Sorptive resins are also available for removal of organics and the removal mechanism is one of sorption rather than ion exchange.

Ion exchange can be used to remove a broad range of ionic species from water including: all metallic elements when present

as a soluble species, inorganic anions, organic acids, and organic amines. Sorptive resins can remove a wide range of polar and non-polar organics.

Ion exchange is a well established technology for removal of heavy metals and hazardous anions from dilute solutions. Ion exchange can be expected to perform well for these applications when fed wastes of variable composition, provided the system's effluent is continually monitored to determine when resin bed exhaustion has occurred. Consideration must be given to disposal of contaminated ion exchange regeneration solution.

Reverse osmosis is the application of sufficient pressure to the concentrated solution to overcome the osmotic pressure and force the net flow of water through the membrane toward the dilute phase. This allows the concentration of solute to build up in a circulating system on one side of the membrane while relatively pure water is transported through the membrane. Ions and small molecules in true solution can be separated from water by this technique.

Reverse osmosis is used to reduce the concentrations of dissolved solids, both organic and inorganic. In treatment of waste streams the use of this process would be primarily limited to polishing low flow streams containing highly toxic contaminants. Good removal can be expected for high molecular weight organics and charged anions and cations. Multivalent ions are treated more effectively than are univalent ions. Recent advance in membrane technology have made it possible to remove such low molecular weight organics as alcohols, ketones, amines, and aldehydes.

Reverse osmosis is an effective treatment technology for removal of dissolved solids presuming appropriate pretreatment

has been performed for suspended solids removal, pH adjustments, and removal of oxidizers, oil, and grease. Because the process is so susceptible to fouling and plugging, on-line monitors may be required to monitor pH, suspended solids, etc. on a continuous basis. Reverse osmosis has not been widely used for treatment of hazardous waste streams.

Reverse osmosis will not reliably treat wastes with a high organic content, as the membrane may dissolve in the waste. Lower levels of organic compounds may also be detrimental to the unit's reliability, as biological growth may form on a membrane fed an influent containing biodegradable organics.

Neutralization consists of adding acid or base to a waste in order to adjust its pH. The most common system for neutralizing acidic or basic waste streams utilizes a multiple compartmental basin usually constructed of concrete. This basin is lined with acid brick or coated with a material resistant to the expected environment.

Neutralization can be applied to any wastewater requiring pH control. It is a relatively simple unit treatment process which can be performed using readily available equipment. Only storage and reaction tanks with accessory agitators and delivery systems are required. Because of the corrosivity of the wastes and treatment reagents, appropriate materials of construction are needed to provide a reasonable service-life for equipment. The process is reliable provided pH monitoring units are used.

Neutralization of wastestreams has the potential of producing air emissions. Acidification of streams containing certain salts, such as sulfide, will produce toxic gases. Feed tanks should be totally enclosed to prevent escape of acid fumes.

Adequate mixing should be provided to disperse the heat of reaction if wastes being treated are concentrated. The process should be controlled from a remote location.

Gravity Separation is a purely physical phenomenon in which the oil is permitted to separate from water in a conical tank. It offers a straightforward, effective means of phase separation provide the oil and water phases separate adequately within the residence time of the tank. Simple, readily available equipment can be used and operational requirements are minimal. Consideration must be given to the disposal of the extracted waste constituents collected.

Air Stripping is a mass transfer process in which volatile contaminants in water or soil are transferred to gas. stripping is frequently accomplished in a packed tower equipment with an air blower. The packed tower works on the principle of countercurrent flow. The water stream flows down through the packing while the air flows upward, and is exhausted through the top. Volatile, soluble components have an affinity for the gas phase and tend to leave the aqueous stream for the gas phase. the cross-flow tower, water flows down through the packing as in the countercurrent packed column, however, the air is pulled across the water flow path by a fan. The coke tray aerator is a simple, low maintenance process requiring no blower. being treated is allowed to trickle through several layers of This produces a large surface area for gas transfer. Diffused aeration stripping and induced draft stripping sue aeration basins similar to standard wastewater treatment aeration basins. Water flows through the basin from top to bottom or from one side to another with the air dispersed through diffusers at the bottom of the basin. The air-to-water ratio is significantly lower than in either the packed column or the cross-flow tower.

In recent years, air stripping has gained increasing use for the effective removal of volatile organics from aqueous wastestreams. It has been used most cost-effectively for treatment of low concentrations of volatiles or as a pretreatment step prior to activated carbon. The equipment for air stripping is relatively simple, start-up and shut-down can be accomplished quickly, and the modular design of packed towers makes air stripping well suited for waste site applications.

Oxidation or reduction-oxidation reactions are those in which the oxidation state of at least one reactant is raised while that of another is lowered. In chemical oxidation, the oxidation state of the treated compound is raised. Common commercially available oxidants include potassium permanganate, hydrogen peroxide, calcium or sodium hypochlorite and chlorine gas. Chemical oxidation is used primarily for detoxification of cyanide and for treatment of dilute wastestreams containing oxidizable organics. Among the organics for which this treatment has been reported are aldehyde, mercaptans, phenols, benzidine, unsaturated acids and certain pesticides.

Chemical reduction involves the addition of reducing agent which lowers the oxidation of a substance in order to reduce toxicity or solubility or to transform it to a form which can be more easily handled. See the earlier discussion of in-situ chemical treatment processes which includes chemical reduction for more technical details.

With respect to aqueous liquids commonly used reducing agents include sulfite salts, sulfur dioxide and the base metals (iron, aluminum and zinc). Chemical reduction is used primarily for reduction of hexavalent chromium, mercury and lead. Very simple equipment is required for chemical reduction. This includes storage vessels for the reducing agents and perhaps for

the wastes, metering equipment for both streams, and contact vessels with agitators. Some instrumentation is required to determine the concentration and pH of the waste and the degree of completion of the reduction reaction. Chemical reduction is a well demonstrated technology for the treatment of lead, mercury, and chromium.

# <u>Solids</u>

The treatment of solids involves their separation from slurries and their classification by grain size. The objective of separating solids is to attain two distinct waste streams: a liquid that can be treated for removal of dissolved and fine suspended contaminants; and a concentrated slurry that can be dewatered and treated.

Classification of particles according to grain size may be undertaken for one of two reasons. First, is that more efficient use can be made of equipment and land area by taking advantage of the differences in settling velocity of different sized particles. Second, there is recent evidence to suggest that classification by grain size is important in managing contaminated soils because of the apparent tendency of contaminants to adsorb preferentially onto fine-grained materials.

# o Separation

Solids separation methods include sieves and screens, hydraulic and spiral classifiers, cyclones, settling basins and clarifiers. These are all well demonstrated technologies that are widely adapted in industrial processes and wastewater treatment.

Sieves or screens consist of bars, woven wire or perforated plate surfaces which retain particles of a desired size range

while allowing smaller particles and the carrying liquid to pass through the openings in the screening surface. Types of sieves or screens include grizzlies, moving screens and fixed screens.

Hydraulic classifiers are commonly used to separate sand and gravel from slurries and classify them according to grain size. These units consist of elevated rectangular tanks with v-shaped bottoms to collect the material. Discharge valves which are located along the bottom of the tank are activated by motor-driven vanes that sense the level of solids as they accumulate. The principal of operation is simple. The slurry is introduced into the feed end of the tank. As the slurry flows to the opposite end, solids settle out according to particle size as a result of differences in settling velocity.

The spiral classifier consists of one or two long, rotating screws mounted on an incline within a rectangularly shaped tub. It is used primarily to wash adhering clay and silt from sand and gravel fractions. The screw conveys settled solids up an incline to be discharged through an opening at the top of the tub. Fines and materials of low specific gravity are separated from sand and gravel through agitation and the abrading and washing action of the screw, and are removed along with the wastewater overflow at the bottom of the tub.

Cyclones and hydroclones are separators in which solids that are heavier than water are separated by centrifugal force. A hydroclone consists of a cylindrical/conical shell with a tangential inlet for feed, an outlet for the overflow of slurry, and an outlet for the underflow of concentrated solids. Cyclones and hydrocyclones contain no moving parts. The slurry is fed to the unit with sufficient velocity to create a "vortex" action that forces the slurry into a spiral and, as the rapidly rotating liquid spins about the axis of the cone, it is forced to spiral

inward and then out through a centrally located overflow outlet. Smaller-sized particles remain suspended in the liquid and are discharged through the overflow. Larger and heavier particles of solids are forced outward against the wall of the one by centrifugal force within the vortex. The solids spiral around the wall of the cyclone and exit through the apex at the bottom of the cone.

A settling basin is an impoundment, basin, clarifier, or other container that provides conditions conducive to allowing suspended particles to settle from a liquid by gravity or sedimentation. The slurry is introduced into the basin and settling of solids occurs as the slurry slowly flows across the length of the basin. Flow out the opposite end of the basin is reduced in its solids content.

Commonly used types of settling basins are impoundment basins, conventional clarifiers and high rate clarifiers. An impoundment basin is earthen impoundment of diked area that is lined in a manner that is appropriate for protecting underlying groundwater. They are used to remove particles in the size range of gravel down to fine silt of 10 to 20 microns with flocculants. Conventional clarifiers are rectangular or circular settling basins which are typically equipped with built-in solids collection and removal mechanisms. A high rate clarifier uses multiple "stacked" plates, tubes, or trays to increase the effective settling surface area of the clarifier and decrease the actual surface area needed to effect settling.

Sedimentation employing impoundment basins are conventional clarifiers is a well established technology for removing particles ranging in size from gravel down to fine silt. Proper flocculation is essential to ensure removal of silt-sized particles. Sedimentation methods have not been widely employed

for classifying solids according to particle size. They can be expected to be less effective in classifying solids than classifiers, cyclones, and screens.

# o Dewatering

Dewatering is a physical unit operation used to reduce the moisture content of slurries or sludges in order to facilitate handling and prepare the materials for final treatment or disposal. Device which can be used to dewater materials include gravity thickeners, centrifuges, filters, and dewatering lagoons.

Gravity thickening is generally accomplished in a circular tank, similar in design to a conventional clarifier. The slurry enters the thickener through a center feedwell designed to dissipate the velocity and stabilize the density currents of the incoming stream. The feed sludge is allowed to thicken and compact by gravity settling. A sludge blanket is maintained on the bottom to help concentrate the sludge. The clarified liquid overflows the tank and the underflow solids are raked to the center of the tank and withdrawn by gravity discharge or pumping. Flocculants are often added to the feed stream to enhance agglomeration of the solids and promote quicker or more effective settling.

Gravity thickeners are used to concentrate slurries and are capable of achieving a solids concentration of approximately 2 to 15 percent. They generally produce the thinnest and least concentrated sludge of all the dewatering methods. The intent in using a gravity thickener is usually to reduce the hydraulic load of a slurry that is to be fed to a more efficient dewatering method. Gravity thickening provides a simple, low maintenance method for concentrating slurries, thereby reducing the hydraulic load to subsequent dewatering processes. They are suitable for

operations where a high degree of operator supervision cannot be provided.

Dewatering lagoons use a gravity or vacuum assisted underdrainage system to remove water. The base of the lagoon is lined with clay plus a synthetic liner or other appropriate liner material to prevent migration of contaminants into the underlying soils and groundwater. At a minimum, the liner consists of a low permeability clay layer which is several feet thick. When the lagoon is no longer in use, the clay liner is excavated and properly disposed.

Dewatering lagoons are best suited to large-scale dewatering operations where the volume of sludge or sediment would require an inordinately large number of mechanical dewatering units.

Lagoons are one of the more effective dewatering methods. A gravity dewatering system is capable of achieving 99 percent solids removal and dewatered cake of 35 to 40 percent solids after 10 to 15 days. The major limitations on the use of dewatering lagoons is that they require large land areas and long set-up times. Because of their large surface area they may not be well suited to areas with heavy rainfall or to areas where long periods of freezing would prevent dewatering.

Centrifugal dewatering is a process which uses the force developed by fast rotation of a cylindrical drum or bowl to separate solids and liquids by density differences under the influence of centrifugal force. Dewatering is usually accomplished using solid bowl or basket centrifuges. Disk centrifuges are also available and are mainly used for clarification and thickening.

Centrifuges can be used to concentrate or dewater soils ranging in size from fine gravel down to silt. Effectiveness of

centrifugation depends upon the particle sizes and shapes, and the solids concentration among other factors. Data from the dewatering of municipal sludges indicate that solids concentrations ranging from about 15 to 40 percent are achievable with the solid bowl centrifuge. Solids capture typically ranges from about 85 to 97 percent with chemical conditioning.

Filtration is a physical process whereby particles suspended in a fluid are separated from it by forcing the fluid through a porous medium. Three types of filtration are commonly used for dewatering: belt press filtration, vacuum filtration, and pressure filtration.

Belt filter presses employ single or double moving belts to continuously dewater sludges. The sludge usually after some conditioning contacts the moving belt(s). The space containing the sludge is gradually decreased as the sludge moves through the process. Progressively more and more water is expelled throughout the process until the end where the cake is discharged.

A vacuum filter consists of a horizontal cylindrical drum which rotates partially submerged in a vat of sludge. The drum is covered with a continuous belt of fabric or wire mesh. A vacuum is applied to the inside of the drum. The wet solids adhere to the outer surface. As the drum continues to rotate, it passes from the cake forming zone to a drying zone, and finally to a cake discharge zone where the sludge cake is removed from the media.